Scripps's Murrelet, Cassin's Auklet, and Ashy Storm-Petrel Colony Monitoring and Restoration Activities on Santa Barbara Island, California in 2010-2011

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EXECUTIVE SUMMARY

- In 2010-2011, we continued habitat restoration activities to benefit Scripps's Murrelets and Cassin's Auklets on Santa Barbara Island as part of the Montrose Settlements Restoration Program.

- Project components included social attraction for Cassin's Auklets, artificial habitat installation, native plant restoration, and reproductive monitoring.

- Cassin's Auklets formed a small new subcolony in Landing Cove in response to the social attraction system there, demonstrating that auditory attraction has great potential for colony restoration of this species.

- New nesting by small numbers of both Cassin's Auklets and Scripps's Murrelets in restoration plots also provided an early indication of restoration success.

- We expanded Scripps's Murrelet nest monitoring to assess efficacy of previous sampling approaches for reproductive success estimates.

- We monitored a total of 272 Scripps's Murrelet clutches in 205 nest sites in 2010 and 125 clutches in 104 nest sites in 2011.

- Island-wide Scripps's Murrelet clutch success was 70% and 68% in 2010 and 2011, respectively. Egg productivity rates were 65% and 63% in 2010 and 2011, respectively.

- Scripps's Murrelet clutch success from nests located in native plant habitat continued to exceed that from nests located in rocky crevices (87% and 70%, respectively); observed first egg depredation rates were 57% from shrub sites versus 80% from crevices.

- Limited data collected for the Ashy Storm-Petrel colony using the mist-net technique at Santa Barbara Island indicated a probable decline over the last decade.

- Adult mortality of nocturnally active seabirds due to native avian predators, particularly Barn Owls and Peregrine Falcons, continues to be of very high concern; more work is needed to determine likelihood of colony persistence for remnant subpopulations.

- Study, monitoring, and restoration recommendations resulting from project work from 2007-2011 are summarized in this report, and include strategies to minimize disturbance effects of human presence on Santa Barbara Island.

- We strongly recommend continued native plant restoration, coupled with a robust monitoring approach, as the best possible method for restoring self-sustaining populations of the small crevice- and burrow-nesting species of Santa Barbara Island.

TABLE OF CONTENTS

TABLE OF CONTENTS continued.

LIST OF FIGURES

LIST OF TABLES

LIST OF TABLES continued.

LIST OF APPENDICES

INTRODUCTION

The Santa Barbara Island (SBI) alcid habitat restoration project, which is funded by the Montrose Settlements Trustee Council (MTC) and their partners, commenced in 2007 (MSRP 2005, 2012). The overarching goal of this project is to increase native plant habitat to improve reproductive success on SBI for two species: Cassin's Auklet (*Ptychoramphus aleuticus*; CAAU) and Scripps's Murrelet (*Synthliboramphus scrippsi*; SCMU). To meet this goal, we focused on restoring potential nesting areas from a predominantly invasive annual plant cover to a structurally complex native shrub habitat that would provide suitable habitat for SCMU, which nest under native shrubs, and CAAU, which require stable soil structure to support burrow colonies. Annual monitoring for both species was conducted to assess reproductive success and to provide information with which to assess the outcome of the longer term habitat restoration project.

At the completion of the 2011 winter outplanting season (through February 2012), we were actively restoring approximately five acres distributed among five main restoration plots of varying sizes, and had installed nearly 20,000 native perennial shrubs from fall 2007 through winter 2012. Site selection was based on both historical and contemporary information regarding the distribution of the two species, as well as a qualitative assessment of the restoration potential of microhabitats on SBI. Positive selection criteria for restoration areas included: proximity to known SCMU and CAAU nesting (which theoretically could increase the likelihood of colony expansion into restored areas), presence of a suitable soil horizon for CAAU burrow excavation, paucity of native shrubs in the plot area (i.e. high need for restoration), a mostly northeasterly exposure to reduce wind and thermal loading, slope at a manageable level (i.e. able to safely plant without using ropes), and the practical ability to transport materials and water on backpack frames, as there are no motorized vehicles on SBI.

Negative selection criteria for restoration plot locations included: proximity to (*Pelecanus occidentalis californicus*; BRPE) or cormorant nesting areas noted in prior years so as to reduce disturbance potential of future restoration work, proximity to high densities of known Western Gull (*Larus occidentalis*; WEGU) nesting to avoid potential interspecific competition, a mostly southwesterly exposure, slope at an unmanageable level (i.e. not able to safely plant without using ropes), proximity to long-term vegetation surveys conducted by Channel Islands National Park (CINP) to avoid biasing long-term comparability of vegetation monitoring data (used to document any naturally occurring recovery and also serves as comparison/control data for plant restoration work), good natural shrub cover and/or native recruitment (i.e. no need for restoration). Plant palettes (species compositions) within plots were similar for both species, but were more heavily weighted toward prostrate growth forms for SCMU than for CAAU nesting.

Additional techniques to meet the project's overall goals subsequent to the long-term plant restoration included the use of artificial habitat (nest boxes and burrows) for both species, as well as social attraction for the CAAU colony restoration component. In conjunction with the yearround plant habitat restoration activities, we completed annual standardized land-based (versus periodic at-sea studies, discussed below) reproductive monitoring for SCMU during the breeding seasons in 2007 (Harvey and Barnes 2009), 2008-2009 (Harvey et al. 2012), and 2010-2011 (this report). The purposes of reproductive monitoring in the context of the overall restoration project were to: (1) assess the breeding status of the murrelets and auklets before, during, and after restoration activities; (2) adaptively manage restoration strategies to maximize the likelihood of ultimate project success; (3) identify if differences in reproductive output were present in various nest site types (plant, rocky crevice, and artificial habitat); and (4) continue a standardized and long-term reproductive data time series that, for SCMU, exists uniquely on SBI (Schwemm and Martin 2005, Carter et al. 2005, 2011).

In 2010-2011, in addition to regular surveys of all restoration areas for evidence of colony expansion, we conducted standardized murrelet nest monitoring at the Cat Canyon, Dock, House and Landing Cove plots as in previous years (Harvey et al. 2012). In response to recommendations generated by a larger study of SCMU nesting distribution and status completed in 2009-2010 (Whitworth et al. 2011), we also initiated expanded land-based surveys in 2010-2011. The main goals of this monitoring approach, which was designed to substantially increase sample sizes in terms of both discrete nest sites and monitored areas, were to: (1) determine whether existing monitoring plots adequately characterized island-wide annual reproductive success; (2) assess whether nest occupancy rates observed in plot-based monitoring could be used for colony trend analysis; (3) develop recommendations for a minimum land-based nest monitoring survey strategy that balances survey effort with data accuracy; 4) provide a robust sample size relative to population estimates being concurrently developed (Whitworth et al. 2011); and 5) provide information for continued refinement of restoration techniques, if needed. In this report, we provide recommendations for future restoration and study work based on results from the annual SCMU land-based reproductive surveys and ancillary at-sea mark-recapture work, Ashy Storm-Petrel (*Oceanodroma homochroa*; ASSP) mist-netting efforts, and social attraction and monitoring of CAAU nesting on SBI.

METHODS

We assessed reproductive performance for SCMU in seven land-based nest monitoring plots (“MP”) as follows: Dock Area (MP1), Landing Cove (MP2), House Area (MP3), Boxthorn Patch (MP4), Cat Canyon (MP5), West Cliffs (MP6), and Arch Point North Cliffs (MP7; Figure 1). Monitoring was also conducted in the habitat restoration plots (“RP”) located at Landing Cove (RP1), Northeast Flats (RP2), Prohibition Point (RP3), Coastal Sage Scrub small plots (RP4-8), Elephant Seal Cove Cliffs (RP9) and Beacon Hill (RP10). We netted for Cassin’s Auklets and/or Ashy Storm-Petrels at 5 locations: Signal Peak (NET1), Elephant Seal Point A (NET2), Elephant Seal Point B (NET3), Shag Rock Overlook (NET4), and North Cliffs (NET5).

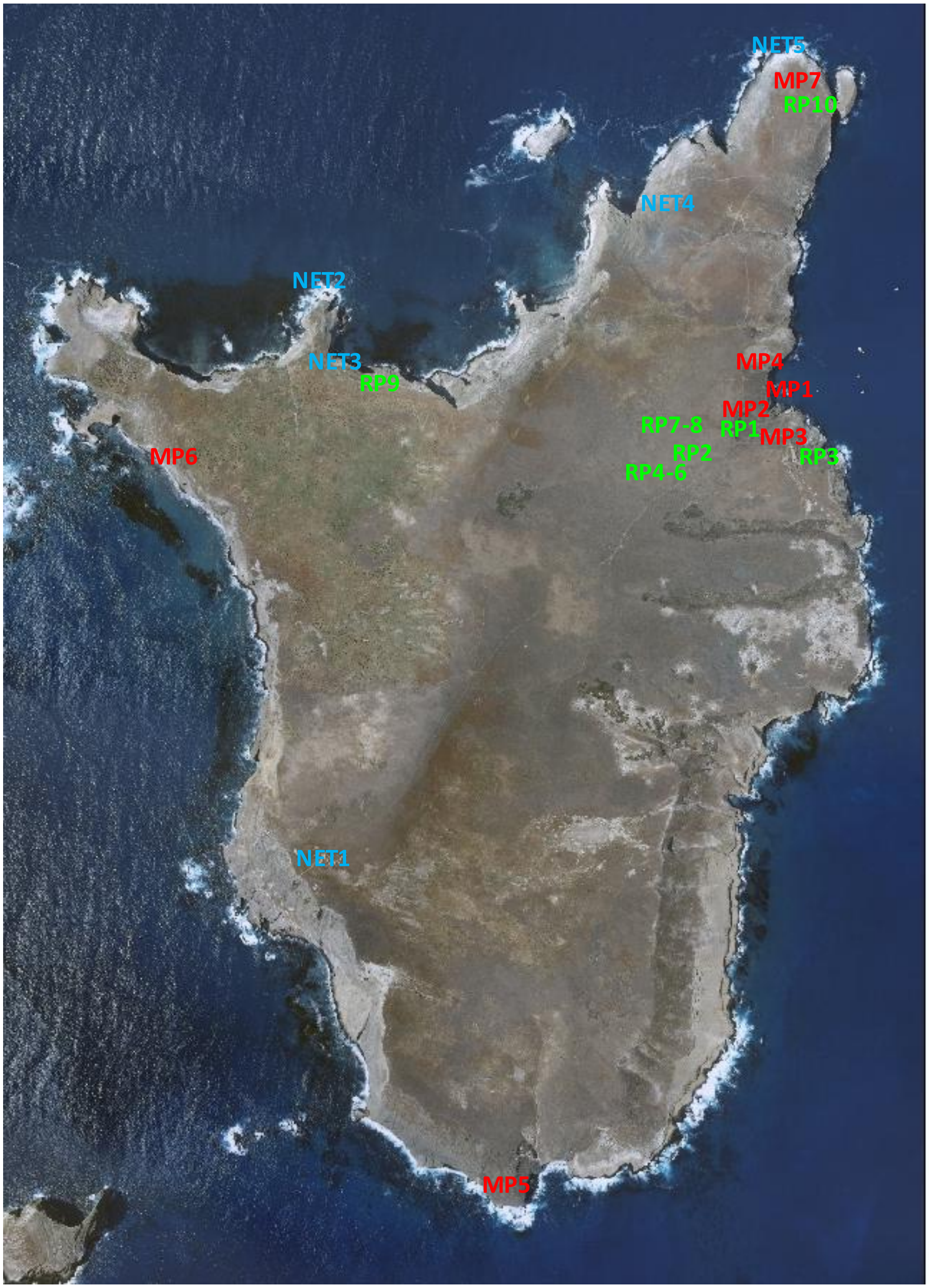

Figure 1. Overview map of mist-netting locations, monitoring plots, and restoration plots on Santa Barbara Island.

SCRIPPS'S MURRELET REPRODUCTIVE MONITORING

Data collection and logistics. Standardized nest monitoring methods for SBI are described in Harvey and Barnes (2009), Harvey et al. (2012), and references therein; methodology in 2010-2011 followed those previously described protocols. Briefly, nest contents were examined using a handheld flashlight; adults were not handled. Accessible, unattended eggs (see Murray et al. 1983 for description of egg neglect and other breeding biology attributes of the SCMU) were individually labeled for clutch order determinations, photographed, measured (sample only), and assigned a color identifier to assist with clutch fate determinations (murrelet egg colors often vary markedly within clutches). Eggshell fragments were removed from nest sites to assist with ultimate egg fate determinations. Beginning in 2009, and continuing in the present study, nest monitoring data were recorded in the field using a PDA rather than in paper notebooks; data entry fields are itemized in Appendix 1. Beginning in 2010, eggshells were removed and stored (frozen) on the mainland office for possible future genetic studies. Plot boundaries and individual nest site locations were mapped using handheld Garmin GPS units; position errors averaged roughly four meters. Aerial photographs used for GIS graphics were taken in 2009 (R. Rudolph pers. comm.). Monitoring schedules generally were coordinated around CINP weekly transportation (typically Wednesday boats; Table 1, Appendix 2 and 3), and seabird restoration staff were housed in the CINP residence on SBI. Helicopters (Aspen) were contracted to access the island if boats were not available. In 2010-2011, we maintained blackout curtains installed in 2008 in the CINP residences to curtail light emission (Harvey et al. 2012) and implemented other disturbance reduction efforts as needed (discussed below).

Table 1. Basic survey intervals in SCMU monitoring plots in 2010 and 2011. See text for details and Appendices 1 and 2 for all survey dates.

Year	Plot	Survey Date Range	Interval (days)	Final Survey	Total
2010	Cat Canyon	4 March to 22 July	4 to 6	27-Jul	31
	Landing Cove	5 March to 12 July	3 to 11	25-Jul	22
	House	5 March to 14 July	5 to 7	21-Jul	22
	Dock	5 March to14 July	6 to 8	21-Jul	22
	Arch Point North Cliffs	6 March to 12 July	3 to 11	23-Jul	20
	Boxthorn Patch	9 March to23 June	6 to 13	7-Jul	16
	West Cliffs	7 March to 24 July	12 to 15	3-Aug	12
2011	Cat Canyon	3 March to 3 July	4 to 6	10-Jul	28
	Landing Cove	4 March to 24 June	6 to 9	1-Jul	18
	House	2 March to 6 July	6 to 8	13-Jul	22
	Dock	2 March to 29 June	6 to 8	12-Jul	19
	Arch Point North Cliffs	4 March to 1 July	6 to 8	9-Jul	18

SCMU land-based survey effort and area, 2010-2011. In addition to monitoring plant restoration areas for new nesting (see below), we regularly monitored a total of seven plots which contained adequate nest samples in 2010: Cat Canyon (CC), Landing Cove (LACO), House (BH), Dock (DO), Boxthorn (BT), West Cliffs (WC), and Arch Point North Cliffs (APNC). In 2011, we monitored five plots: Cat Canyon, Landing Cove, House, Dock, and Arch Point North Cliffs. We monitored all accessible sites in the plots, including potential sites found in pre-breeding season searches. In total, nest surveys in CC, LACO, House, Dock, ESC, WC, BT, and APNC in 2010 were conducted on 89 individual days between 3 March and 3 August (Appendix 2); some surveys in 2010 were conducted in conjunction with the study reported in Whitworth et al. (2011). In 2011, we conducted surveys on 69 individual days at LACO, House, Dock, and APNC between 2 March and 13 July (Appendix 3).

Cat Canyon. Search area at Cat Canyon was slightly reduced from 2008-09 surveys (Figure 2). In 2010, a small portion of the plot was not accessible due to nesting BRPE in Cat Canyon proper (8 tagged sites were not surveyed after 8 March: historic nest numbers 63 and 65-69 and additional tags 592-593, plus surrounding untagged available habitat). In 2011, 19 tagged sites (8 historic and 11 nonhistoric) were not surveyed during the breeding season for the same reason. Surveys in this plot were conducted at approximately 5 day intervals in both years (range 4-6 days).

In 2010, we conducted 31 surveys at Cat Canyon between 4 March and 22 July, with a follow-up survey on 27 July to determine if any late nesting had occurred. In 2011, we completed 28 nest surveys between 3 March and 3 July and conducted the follow-up survey on 10 July. We surveyed all previously tagged accessible sites in both years as well as all potential nesting habitat in the plot area. In 2010, 69 of 155 tagged sites were classified as “historic” (see Harvey and Barnes 2009, Schwemm et al. 2005 for discussion); in 2011, 61 of the 142 monitored sites were classified as historic. We reported nest site occupancy separately for the historic site catalogue as in previous years as well as combined (overall) plot occupancy and reproductive success (Roth et al. 1999, Schwemm and Martin 2005, Harvey and Barnes 2009, Harvey et al. 2012).

Northeastern Areas. In 2010-11, we continued to monitor the Northeastern Areas (Landing Cove, House, and Dock plots). In 2010 we completed 22 surveys each at the Dock (6 to 8 day intervals), House (5 to 7 day intervals), and Landing Cove (3 to 11 day intervals) areas between 5 March and 14 July, and conducted follow-up surveys on 21 and 25 July to determine if any late nesting had occurred (Appendix 2). In 2011, we completed 19, 22, and 18 surveys at the Dock (6 to 8 day intervals), House (6 to 8 day intervals), and Landing Cove (6 to 9 day intervals) areas, respectively, between 2 March and 29 June with follow-up surveys on 1, 12, and 13 July 2011. Survey areas in the Dock and House plots were identical in both years (as in 2007-2009), but available habitat was much increased in the House plot due to growth of native shrubs installed during the course of plant restoration activities (Harvey et al. in prep). Dock plot available habitat also changed among years, discussed below. The Landing Cove plot survey area was slightly smaller in 2011 than in 2010 due to Brown Pelican nesting at the southern edge of the Landing Cove plot in that year. The Landing Cove plot area thus decreased from 2.6 acres in 2010 to 2.3 acres in 2011 (Figure 3).

Additional monitoring plots. In 2010-2011, we expanded SCMU monitoring on SBI to determine whether our existing sample areas adequately represented overall colony reproductive activity (expanding on work reported in Whitworth et al. 2011). In 2010, we monitored three additional plots as follows: Arch Point North Cliffs (20 checks at 3 to 11 day intervals; Figure 4), West Cliffs (12 checks at 12 to 15 day intervals; Figure 5), Boxthorn Patch (16 checks at 6 to 13 day intervals; Figure 6). In 2011, we discontinued monitoring in the BT and WC plots, but continued to monitor APNC, completing 18 checks between 4 March and 1 July (follow-up survey 9 July; 6 to 8 day survey interval) that year.

Restoration plot monitoring for colony expansion detection. We monitored all restoration plots routinely (at least bimonthly) for SCMU and CAAU nesting activity, including artificial habitat in LACO, ESC, and NEF plots, to assess whether either species were expanding into these areas.

SCMU nesting activity and breeding phenology definitions. Active (also “occupied”) murrelet sites were defined as those with evidence of egg-laying (i.e. eggs seen, chicks seen, or adult in nest during daylight hours). We reported nest initiation as the date the first egg of the clutch was laid, as SCMU clutch completion (i.e. date second egg is laid) typically occurs approximately 8 days after the first egg is laid (range 5-12 days; Murray et al. 1983). Egg-laying dates were determined either by direct observation or by estimating date based on published mean periods between clutch initiation, completion, incubation, and hatching (Murray et al. 1983, Whitworth et al. 2009a, Harvey and Barnes 2009). For example, for those nests where egg laying date was not directly observed during early surveys (i.e. a first observation with a bird incubating in nest), lay dates were calculated based on observed hatch date by subtracting 43 days and 35 days from observed hatch date for first and second eggs, respectively. Data were analyzed separately and together for sites with multiple clutches. Error rates were recorded and archived as the most conservative value resulting from either direct observation or ± the median interval between observations (survey dates) but are not reported herein.

SCMU reproductive success statistics: “clutch success” and “egg productivity”. We assumed that SCMU are able to lay a maximum of two eggs per clutch (see Harvey et al. 2012 and references therein for discussion of multiple clutches within discrete nest sites); three or more eggs within a discrete nest site therefore were identified as part of a separate clutch (also “attempt”). In the event that a clutch was comprised of only one (observed) egg, we assumed that sequential egg-laying represented a separate clutch if: a) one additional egg was subsequently laid after published periods of egg neglect had elapsed (see Murray et al. 1983), *or*

b) if a concurrent or later clutch of 2 eggs was laid. In the event that more than 4 eggs were laid in a discrete nest site, the same logic was employed to identify the ultimate number of clutches over the course of the season.

As in 2007-09, we reported two measures of reproductive success (RS): (1) "egg productivity" as number of eggs hatched per total number of eggs laid (EP; comparable to long-term NPS "productivity" metric for the SBI colony), and (2) "clutch success" as those clutches where at least one egg ultimately hatched (CS, analogous to and previously dubbed "hatching success" and so called in RS reports from other islands; see Harvey et al. (2012) for discussion). Eggs and clutches with unknown fates were excluded from calculations.

Egg fates. Egg fates for each murrelet clutch were categorized as hatched or failed; primary causes of failed eggs were further classified as: depredated (presumably by mice), broken, disappeared, abandoned, addled, rolled out, kicked out, usurped (i.e. evidence of second SCMU or CAAU pair associated with failure of first pair, or vice versa), or fate unknown. Hatching was confirmed by either the presence of chicks, hatched eggshell fragments (indicated by paper-like, detached membranes following sufficient incubation period), or by a sufficient incubation period followed by egg disappearance without evidence of egg or chick mortality.

As in previous years, depredation rates were calculated as the total percentage of eggs laid that were apparently eaten by mice prior to hatching (usually identified by an insufficient incubation period coupled with characteristic shiny, intact membrane and small tooth marks on the broken eggshells, or by nearly-hatched eggs depredated before chick departure; see Schwemm and Martin 2005). Egg failure fates were further classified, to the extent possible, by the nesting stage at which they occurred: 1) during the neglect period between first egg-lay and clutch completion; or 2) during the incubation period; or 3) at unknown stage. Eggs with unknown fates were excluded from analysis. To provide a parsimonious depredation statistic, failed eggs observed as depredated without high confidence that the primary cause of failure was due to mouse depredation, versus, for example, nest abandonment followed by scavenging, were excluded from depredation rate calculations (see Harvey et al. 2012). Clutches where egg-laying order was unknown were excluded from calculations of depredation for first versus second eggs.
SCMU data comparability among years and islands. The reproductive success statistics reported in the present study are comparable to 2007 (Harvey and Barnes 2009), 2008, and 2009 (Harvey et al. 2012) data from SBI, unless otherwise noted in this paper. Direct comparison between these data and reproductive success parameters reported for the SBI colony prior to 2007, as well as for islands (e.g. Anacapa: Whitworth et al. 2013, San Benitos: Wolf et al. 2005, Islas Los Coronados: Carter et al. 2006), are possible but should be approached with caution, discussed below.

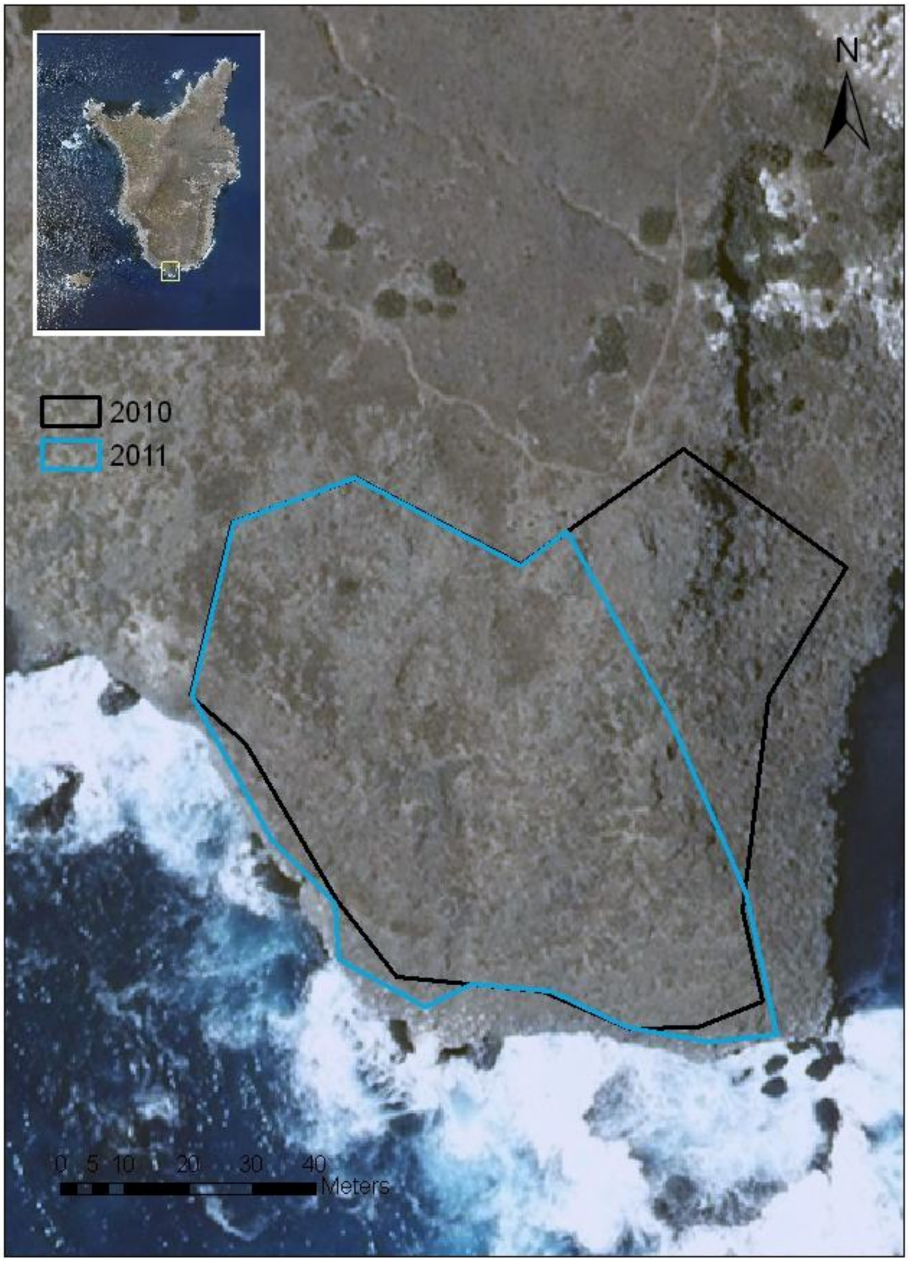

Figure 2. The Scripps's Murrelet Cat Canyon basic monitoring plot survey areas in 2010-2011. See text for details.

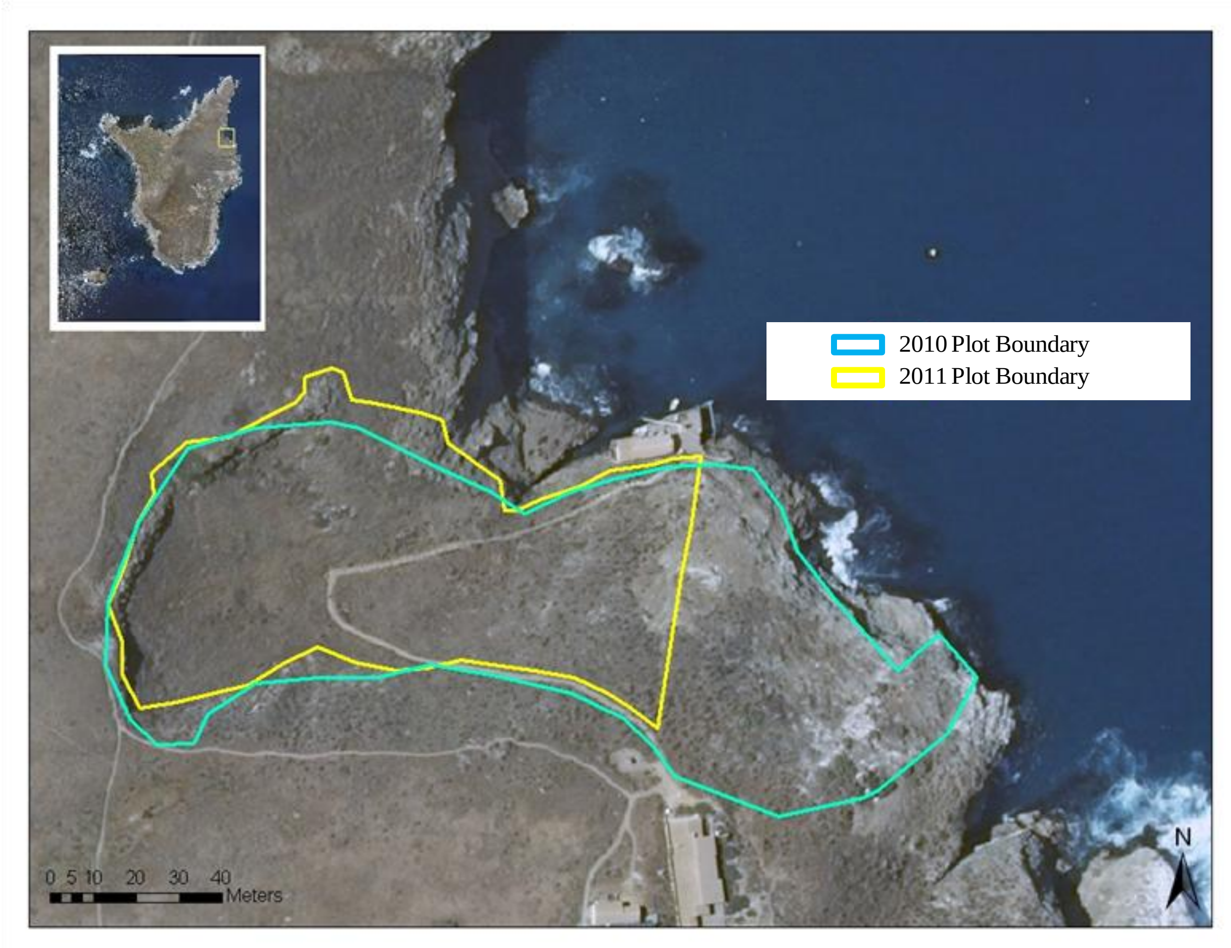

Figure 3. The Scripps's Murrelet Landing Cove monitoring plot survey area in 2010 and 2011 (2.6 and 2.3 acres, respectively).

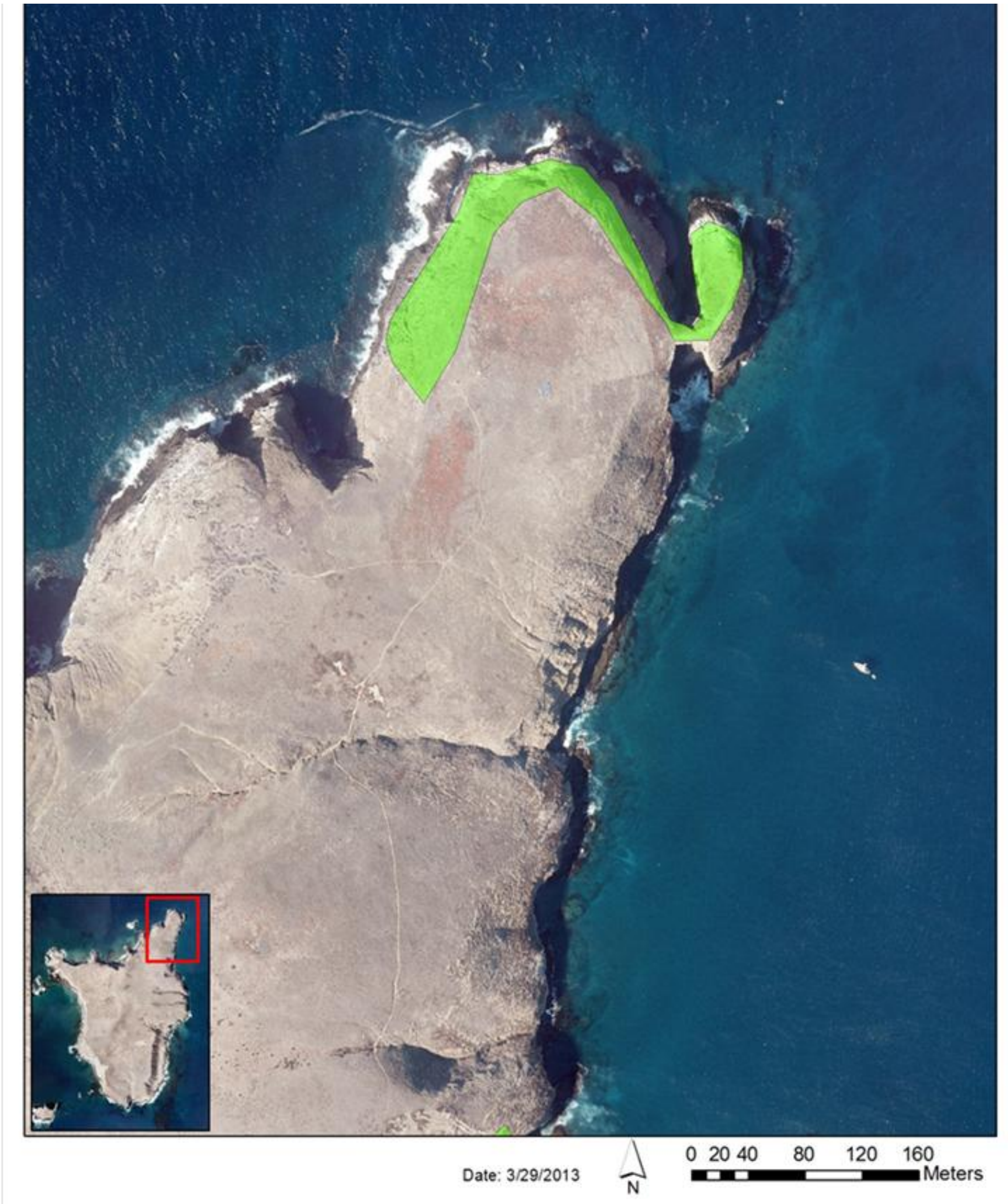

Figure 4. The Scripps's Murrelet Arch Point North Cliffs monitoring plot survey area in 2010 and 2011 (2.8 acres).

Figure 5. The Scripps's Murrelet West Cliffs monitoring plot survey area in 2010 (0.5 acres).

Figure 6. The Scripps's Murrelet Boxthorn Patch monitoring plot survey area in 2010 (0.32 acres).

Scripps's Murrelet at-sea mark-recapture efforts. Dip-net captures were conducted on six nights in 2010: 15-16 March; 3, 10, and 30 May, and 1 June; details of the 2010 capture effort are reported in Whitworth et al. (2011). In the following year, we conducted limited at-sea captures using the NPS crane to launch an inflatable Zodiac with 20 hp engine from the SBI dock. To ensure safety without a support vessel present, captures were only attempted in calm sea conditions in the vicinity of the Landing Cove with additional safety equipment (e.g. EPirb) aboard. Three experienced crew captured and banded birds in the Zodiac, while a fourth person remained on the island in continuous line-of-sight radio contact for an additional safety factor. We attempted captures on three nights in 2011 (12 May: 21:58-23:18hrs, 13-14 May: 21:27-01:47hrs, and 16 May: 21:45); however, capture efforts on 16 May were abbreviated due to problems with equipment. We recorded subspecies, brood patch score (absent, defeathering, bare/vascularized, or refeathering), and band number (size 2 incoloy USGS bands, permit #22539) during capture sessions.

Scripps's Murrelet nest camera study. We began a small pilot study in 2010-2011 using infrared nest cameras to investigate the largely unknown breeding biology of this species. Results of the study helped us to interpret the monitoring findings of the present study, but details are not presented in this report.

CASSIN'S AUKLET SOCIAL ATTRACTION AND CAPTURES

We commenced social attraction using a dusk to dawn broadcast schedule (system designed by Murremaid Inc., S. Schubel) on 12/14/2009 using speakers located in NEF and upper LACO. Vocalizations were provided by J. Adams (USGS). We installed artificial burrows in three areas: Northeast Flats 12/14/2009; LACO (upper) 12/14/2009; ESC 12/15/2009; n=20 burrows each for a total of 60 burrows installed prior to the 2010 breeding season. In 2011, we added 40 artificial burrows to the LACO plot and moved speakers (see below for details). Results of at-sea and mist-netting efforts for CAAU in 2010 are reported in Whitworth et al. (2011). We did not attempt mist-netting for CAAU in 2011 to avoid disturbing a Brandt's Cormorant (*Phalacrocorax penicillatus*, BRAC) nesting subcolony at the net site on Elephant Seal Point A (Figure 1).

STORM-PETREL MARK-RECAPTURE AND NEST MONITORING

We conducted mark-recapture efforts primarily for the Ashy Storm-Petrel, with limited effort also expended to detect the presence of Black (*O. melania*; BLSP) and Leach's Storm-Petrels (*O. leucorhoa*; LHSP). To the extent possible, we standardized capture methods and locations at SBI to those used in previous studies (e.g. Carter et al. 1992, Wolf et al. 2000). As in those (and other) previous studies, we lured petrels to mist nets (Avinet: 2.6x9 meters, 4 shelves, 38 mm mesh) using (a) portable CD players and later (b) MP3 players. We used decibel meters to standardize, to the extent possible, audio broadcast systems used in this study to broadcast levels used by Carter et al. (1992) to minimize potential bias in capture rates which could result from more powerful technology (e.g. increased broadcast range). Vocalizations for ASSP, BLSP, and LHSP were provided by H. Carter; these vocalizations were originally recorded at SEFI. Netting was conducted during dark nights (week of the new moon) in calm conditions (winds less than 15 knots). We typically played ASSP calls from 22:00 to 01:00; BLSP and LHSP vocalizations were occasionally played after 01:00 to assess presence of these species. Each petrel was fitted with a metal USGS band (on either leg; ASSP: size 1A; BLSP: size 1B); we recorded culmen and tarsus length, body weight, wing chord, and brood patch score after Ainley et al. (1976): defeathering, bare, bare and vascularized, re-feathering, or no incubation patch present.

In 2010, we conducted mist-netting at two locations on five unique nights (4-5 June, 5-6 June, 7 June, 8-9 June, 10-11 June) in 2010 for a total of approximately 14 hours of effort (Table 2). The 7 June survey was abbreviated due to high winds. In 2011, we conducted mist-net captures at four locations on 12 individual nights (4-5 June, 30 June-1 July, 1-2 July, 2-3 July, 3-4 July, 4-5 July, 5-6 July, 27-28 July, 28-29 July, 29-30 July, 27-28 August, 29-30 August) for a total effort of approximately 39 hours (Table 3). In 2010, we continued 24 diurnal nest surveys at APNC after the SCMU breeding season to monitor ASSP nests found there on 24 days between 6 March and 22 September. In 2011, we conducted 25 diurnal nest surveys between 4 March and 9 September.

OTHER SEABIRD SPECIES

We conducted reproductive monitoring for the following additional seabird species as time allowed during both breeding seasons: Pigeon Guillemot (*Cepphus Columba*; PIGU), BRAC, BRPE, Double-crested Cormorant (*Phalacrocorax auritus*, DCCO), Pelagic Cormorant (*Phalacrocorax pelagicus*, PECO), Western Gull, Black Oystercatcher (*Haematopus bachmani*, BLOY). Data are archived at Channel Islands National Park and, except where nesting overlapped with restoration-associated monitoring plots, are not reported here.

Table 2. Petrel mist-net survey dates and locations on SBI in 2010.

Location	Capture Night	Start Time	End Time	Broadcasts played
Shag Rock Overlook	4-5 June	21:55	1:00	ASSP: 21:55-01:00
Shag Rock Overlook	5-6 June	22:05	1:00	ASSP: 22:05-00:00; BLSP: 00:00-01:00
Nature Trail (abbreviated survey)	*7 June*	*22:30*	*23:35*	*ASSP: 22:30-23:00; BLSP: 23:00-23:35*
Shag Rock Overlook	8-9 July	22:00	1:31	ASSP: 22:00-01:00; BLSP: 01:00-01:31
Shag Rock Overlook	10-11 July	22:00	1:34	ASSP: 22:00-01:34; LHSP: 01:00-01:34

Table 3. Mist-net capture efforts for Ashy, Black, and Leach's Storm-Petrels on SBI in 2011.

Location	Capture Night	Start Time	End Time	Broadcasts played
Shag Rock Overlook	4-5 June	22:00	1:05	ASSP 22:00-01:05
Elephant Seal Cove Overlook	30 June-1 July	22:00	1:33	ASSP 22:00-01:00; BLSP 01:00-01:33
Shag Rock Overlook	1-2 July	22:00	1:34	ASSP 22:00-01:00; BLSP 01:00-01:34
Shag Rock Overlook	2-3 July	22:15	2:36	ASSP 22:15-01:14; BLSP 01:14-01:58; LHSP 0158-02:36
North Cliffs	3-4 July	22:00	1:45	ASSP 22:00-22:16; BLSP 22:16-01:45
Signal Peak	4-5 July	22:00	1:02	ASSP 22:00-01:02
Elephant Seal Cove Overlook	5-6 July	22:00	1:00	ASSP 22:00-01:00
North Cliffs	27-28 July	22:00	1:01	ASSP 22:00-01:01
Shag Rock Overlook	28-29 July	22:00	1:00	ASSP 22:00-01:00
Elephant Seal Cove Overlook	29-30 July	22:00	1:00	ASSP 22:00-01:00
Elephant Seal Cove Overlook	27-28 August	22:00	1:00	ASSP 22:00-01:00
Elephant Seal Cove Overlook	29-30 August	22:00	1:00	ASSP 22:00-01:00

RESULTS

Storm-petrel mark-recapture surveys. In 2010, we captured and banded a total of 20 storm-petrels (all at the Shag Rock overlook; Table 4, Appendix 4a) as follows: 20 novel ASSP captures (no recaptures); zero BLSP; zero LHSP. No petrels were captured during the abbreviated survey night at Nature Trail on 7 June. Capture rates were very low during the seven surveys at Shag Rock overlook; the maximum capture rate (7 birds) occurred on 5 June. Seasonal trends could not be estimated from this small sample size.

The larger survey effort in 2011 resulted in a slightly improved sample size: we captured a total of 94 storm-petrels and banded 87 new individuals as follows: 83 novel (banded) ASSP captures plus two recaptures, each of which had been banded and released from the same locations earlier in the same survey year (Band # 4501-41375 was first banded at ESC on 6/30/2011 and recaptured at ESC on 7/29/2011; Band # 4501-41336 first banded at SRO on 6/24/2011 and recaptured on 7/2/2011); 9 BLSP captures (4 BLSP were banded and 5 BLSP were released without bands; Appendix 4b); zero LHSP captures or auditory detections (Tables 5, 6). Although sample sizes were low, capture rates appeared to peak in July, with maximum numbers on the night of 1-2 July at the Shag Rock overlook. Seasonal trends could not be reliably estimated, but capture rates appeared to decline after late July. Maximum captures per night in 2011 were similar at ESC, SRO, and North Cliffs (13, 18, and 14 birds respectively). In 2010, 70% of captured ASSP had partial or full brood patches, versus 66% in 2011 (Table 6). Average measurements of ASSP body weight and culmen, tarsus, and wing chord lengths did not differ appreciably between 2010 and 2011 (Table 7).

Table 4. Total captures and breeding status of Ashy Storm-Petrels captured in mist-nets at SBI in 2010 at the Shag Rock Overlook net site.

Survey Night	Total Captures	Brood Patch
6/4/2010	1	0
6/5/2010	7	6
6/6/2010	1	1
7/8/2010	2	2
7/9/2010	2	2
7/10/2010	4	1
7/11/2010	3	2
Total	**20**	**14**

Table 5. Black Storm-Petrel novel captures at Santa Barbara Island in 2011.

Survey Night 2011	ESC	N. Cliffs	SRO	Signal Peak	Total
4-5 June					**0**
30 June-1 July			1		**1**
1-2 July			1		**1**
2-3 July					**0**
3-4 July		3			**3**
4-5 July				1	**1**
5-6 July	1				**1**
27-28 July		1			**1**
28-29 July					**0**
29-30 July	1				**1**
27-28 August					**0**
29-30 August					**0**
Grand Total	**2**	**4**	**2**	**1**	**9**

Table 6. Ashy Storm-Petrel novel captures and breeding status at Santa Barbara Island in 2011. Note that only one location was surveyed per capture night.

Survey Night	Elephant Seal B	North Cliffs	Shag Rock	Signal Peak	Total Captures	Brood Patch	Brood Patch (n)
4-5 June			7		7	6	*6*
30 June-1 July	13				13	8	*13*
1-2 July			18		18	10	*18*
2-3 July			0		0	0	*0*
3-4 July		1			1	1	*1*
4-5 July				5	5	2	*5*
5-6 July	11				11	6	*11*
27-28 July		14			14	11	*14*
28-29 July			8		8	6	*8*
29-30 July	4				4	2	*4*
27-28 August	2				2	2	*2*
29-30 August	0				0	0	*0*
Totals	**30**	**15**	**33**	**5**	**83**	**54**	***82***

Table 7. Petrel morphometrics for individuals captured in mist-nets at Santa Barbara Island in 2010-2011.

	2010	***2011***	
Statistic	**ASSP**	**ASSP**	**BLSP**
n	20	83	8
Average of Culmen Length (mm)	14.3	14.5	16.2
Standard Deviation of Culmen Length	0.52	0.58	0.50
Average of Tarsus Length (mm)	23.4	23.5	32.8
Standard Deviation of Tarsus Length	0.86	0.75	0.78
Average of Wing Chord (mm)	140.9	140.5	176.7
Standard Deviation of Wing Chord	3.0	4.0	2.3
Average of Bird Weight (g)	35.1	35.8	54.4
Standard Deviation of Bird Weight	4.0	3.1	6.1

SCMU breeding phenology. The 2010 nesting season began much earlier (one month) than 2011; earliest egg-laying occurred on 11 Feb in 2010 and on 12 March in 2011 (Table 8, Figure 7). For all plots combined, the median date of clutch initiation for first clutches (subsequent clutches excluded) was 9 days later in 2011 than in the previous year (see Appendix 5 for numeric calendar days corresponding to day of month). Last eggs of the season were laid on 3

July in 2010 and 12 June in 2011. In 2011, island-wide mean first clutch initiation date was on 2 April (SD ± 15 days; n=104 clutches) and the latest clutch initiation occurred on 12 June.

Table 8. Summary statistics for Scripps's Murrelet clutch initiation dates (day of calendar year) at all monitoring locations in 2010-2011. See Appendix 5 for dates.

Year	Statistic	Clutch Initiation Date (all clutches combined)	Clutch Initiation Date (first clutches only)
2010	*N*	*234*	*171*
	Earliest Day	42	42
	Latest Day	184	156
	Mean Day	97	84
	SD	*28*	*18*
	Median Day	86	80
2011	*N*	*114*	*93*
	Earliest Day	71	71
	Latest Day	163	152
	Mean Day	100	92
	SD	*23*	*15*
	Median Day	93	89

The island-wide mean nest initiation (first egg-laying) statistics for all clutches, including sequential clutches in discrete nest sites did not differ greatly between years, falling on calendar days 97 (SD±28.5 days; n=234 clutches) and 100 (SD±23 days; n=114 clutches) in 2010 and 2011, respectively. Mean initiation for first clutches only, however, was significantly different between years ($p<0.001$). While a small amount of variability in average first clutch initiation was present among plots in both years, there was no obvious spatial difference (Figure 7). Island-wide, the first hatching in 2010 occurred on day 84.5; mean hatch date was day 132 ± 26 days; median hatch date occurred on day 125, and the last egg of the season hatched on day 206 (N=169 eggs; Figure 8, Table 9). The first successful egg laid in the 2011 nesting season hatched on day 113; mean and median hatching occurred on day 135 ± 17 days and on day 130, respectively, and the last egg of the season hatched on day 191 (n=78 eggs). Using exploratory statistics, we did not detect a significant difference in mean hatching dates for 2010 vs. 2011 (t-test: $p>0.1$). Likewise, mean hatching date did not differ significantly among plots in either 2010 or 2011 ($p>0.1$).

In summary, the 2010 nesting season lasted 164 days (5.5. months) from first egg laying to latest hatching. The 2011 nesting season from first egg laying to latest hatching was more abbreviated than in the previous year, spanning 120 days.

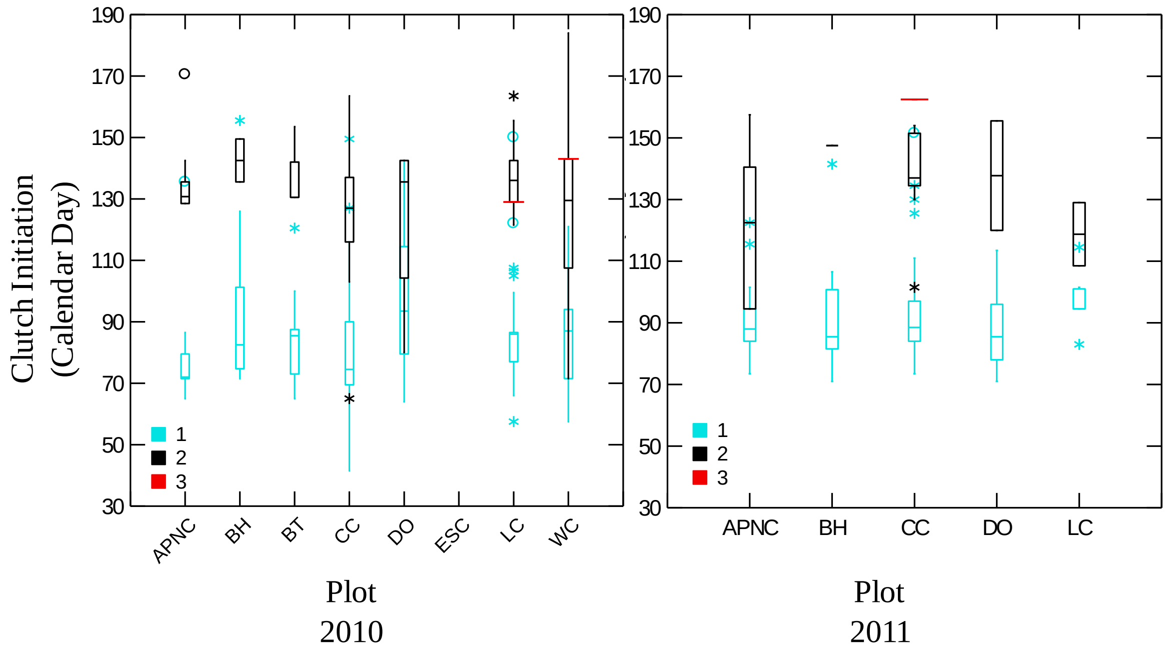

Figure 7. Boxplots indicating distributions of Scripps's Murrelet first egg-laying dates for first (blue), second (black), and third (red) clutches in 2010 (left) and 2011 (right) at Santa Barbara Island.

Table 9. Summary statistics for Scripps's Murrelet hatching dates (day of calendar year) at all Santa Barbara Island monitoring locations in 2010-2011.

Year	Statistic	Hatching Date (all clutches combined)
2010	*N*	*169*
	Earliest Hatch Day	85
	Latest Hatch Day	206
	Mean Hatch Day	132
	SD	*26*
	Median Hatch Day	125
2011	*N*	*78*
	Earliest Hatch Day	113
	Latest Hatch Day	191
	Mean Hatch Day	135
	SD	*17*
	Median Hatch Day	130

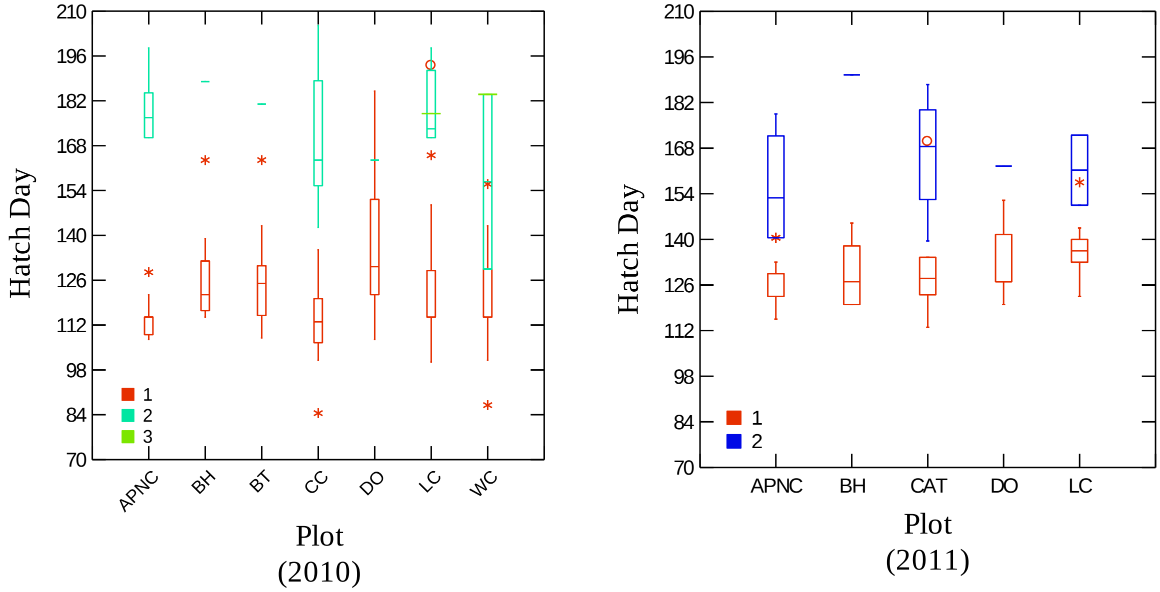

Figure 8. Boxplots depicting island-wide hatching date distributions by clutch order in 2010 (left) and 2011 (right) at Santa Barbara Island. See text for sample sizes and details.

SCMU Reproductive Success and Nest Site Occupancy, 2010-2011. We monitored a total of 272 clutches in 205 nest sites in 2010 and 125 clutches in 104 nest sites in 2011 (Table 10, 11, 12, 13, 14, 15). Island-wide (all plots combined) clutch success was 70% and 68% in 2010 and 2011, respectively (Figure 9). Egg productivity rates were 65% and 63% in 2010 and 2011, respectively (Table 16).

Table 10. Total number of Scripps's Murrelet clutches and active sites in standardized monitoring areas on Santa Barbara Island, 2010-2011. Active sites may not represent comparative densities among years; see text for details.

	2010		**2011**	
Plot	**Active Sites**	**Total Clutches**	**Active Sites**	**Total Clutches**
Dock	21	25	16	18
House	14	18	15	16
Landing Cove	47	60	12	14
Cat Canyon	46	63	39	50
West Cliffs	25	38	--	--
Boxthorn Patch	25	29	--	--
Arch Point North Cliffs	27	39	22	27
Totals	**205**	**272**	**104**	**125**

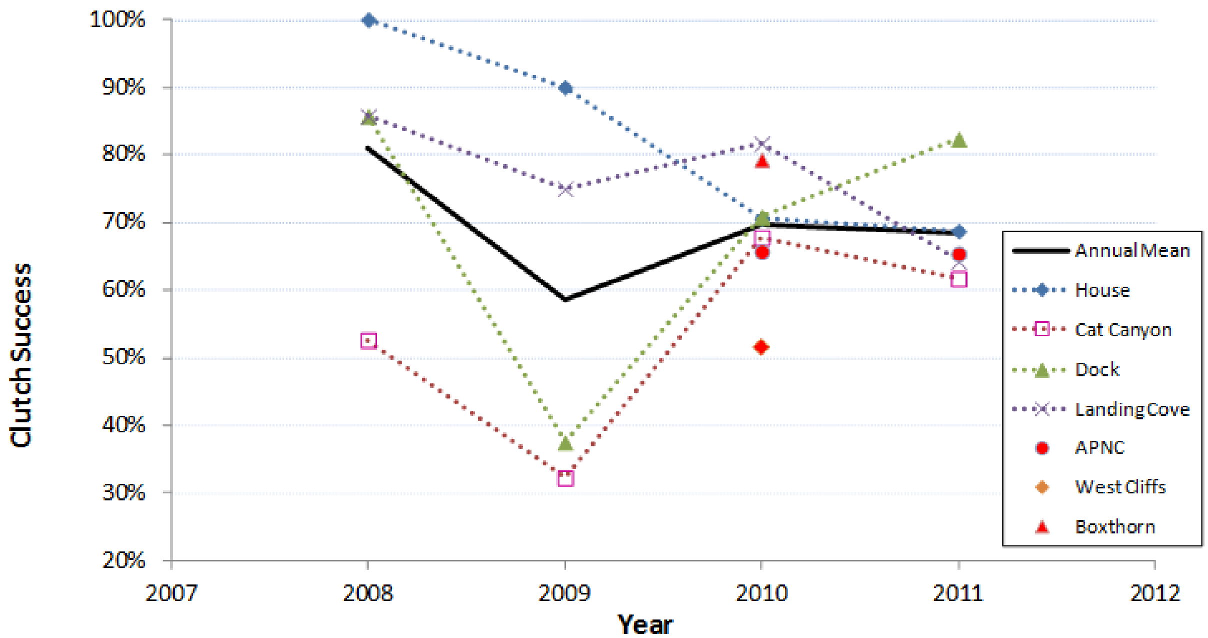

Figure 9. Scripps's Murrelet clutch success at Santa Barbara Island land-based monitoring plots in 2008-2011. See text for sample sizes and Harvey et al. (2012) for 2008-2009 data.

Northeastern monitoring areas. In 2010, we monitored 82 active SCMU nest sites in the Northeastern plots (Dock, House, and Landing Cove combined): 21 in the Dock area, 47 in LACO, and 14 associated with housing structures (Table 10). Combined clutch success from Dock, House, and LACO plots was 77% (n=101 clutches). Seven of fifteen nest boxes (B12, 14, 15, 17, 18, 20, 25) were active at the Dock in 2010; clutch success from this artificial habitat was 75% (n=8). Additionally, 8 clutches in an estimated 6 individual nest sites were laid in a stack of lumber located behind the dock house in 2010; of these, only 4 clutches (57%; n=7) succeeded. This lumber pile was most likely disturbed periodically throughout the season, and was removed prior to the 2011 breeding season to eliminate failures caused by human disturbance during routine island maintenance activity (i.e. crane operations and water deliveries) there. Excluding this nesting area, which allows us to compare to 2007-2009 monitoring of comparable available habitat, clutch success was 76% (n=17). Using nest cameras we installed prior to the nesting seasons, we also documented intraspecific competition under the dock, which led to perhaps the first ever documented SCMU nest failure ("site 5") due to aggressive behavior between pairs.

In 2011, we monitored a total of 43 active sites in the Northeastern plots (versus 82 in 2010, see above). The decrease in sample size from the previous year partly reflected the dock habitat reduction described above (5 fewer active sites at the dock in 2011 vs. 2010), resulting from removing temporary, disturbance-prone habitat (see above). There were ultimately 16 and 15 active nests in 2011 at the Dock and House plots, respectively. Eleven of fifteen artificial nest boxes were active at the Dock in 2011 (Box numbers 8, 10, 12, 13, 15, 16, 17, 18, 19, 20, 25) with a reproductive output (from boxes only) similar to the previous year's (see above): 2011 CS=75% (n=12 clutches in 11 boxes) and EP=0.77 (n=22 eggs).

Aside from the relatively small dock plot reduction in sample size, the decreased sample size in 2011 from NE areas combined was primarily due to the fact that we were able to monitor just 12 active sites in Landing Cove (versus 47 in the previous year) due to Brown Pelican nesting in the southeastern plot area. Nest density is therefore not comparable for the Landing Cove plot area among years (see Harvey et al. 2012); data work to identify a standardized core sampling area and nest site availability by type (e.g. shrub species, pelican nest; see below) as well as absolute numbers of active nests per year for a longer time series could be undertaken as part of future studies.

In the NE areas, the percentage of sites with multiple attempts ranged from 19% to 29% for a total of 103 clutches laid in 82 sites in 2010 and from 7 to 17% for a total of 48 clutches in 43 nest sites in 2011 (Table 15). Combined clutch success in the Northeastern plots was 77% in 2010 and 72% in 2011 (n= 101 and 47 clutches, respectively).

Landing Cove plot areas. As noted in the above sections, the Landing Cove monitoring plot size has varied by year due to plot access restrictions caused by close proximity of nesting BRPE in some years, changing staff availability, and, most recently, as available habitat (maturing outplantings and artificial habitat) is increasing through the course of restoration. There is a "core" sampling area which comprises the portion of LACO that has been monitored annually since 2009; we will present results examining comparative annual nest density using a longer time series in a future report, if appropriate (Figure 10).

Cat Canyon monitoring plot. For the historic subset of the CC plot, the occupancy rate (e.g., active nests from historic sites only) decreased slightly from 2010 to 2011; 49% (n=63) of historic nest sites checked in 2010 were occupied versus 43% (n=61) in 2011 (Table 11). Clutch success from the historic sites also declined slightly from 66% (n=41 clutches) in 2010 to 57% (n=30 clutches) in 2011.

Overall clutch success from *all* monitored sites in the CC plot was moderate in both years at 68% (n=59 clutches) in 2010 and 62% (n=47 clutches) in 2011. Plot-wide nest density decreased from 46 active sites in 2010 to 39 in 2011, primarily reflecting decreased search area due to nesting Brown Pelicans (see Figure 2). A total of 63 clutches were laid in the 46 active sites in 2010, while 50 clutches were laid in 39 active sites in 2011.

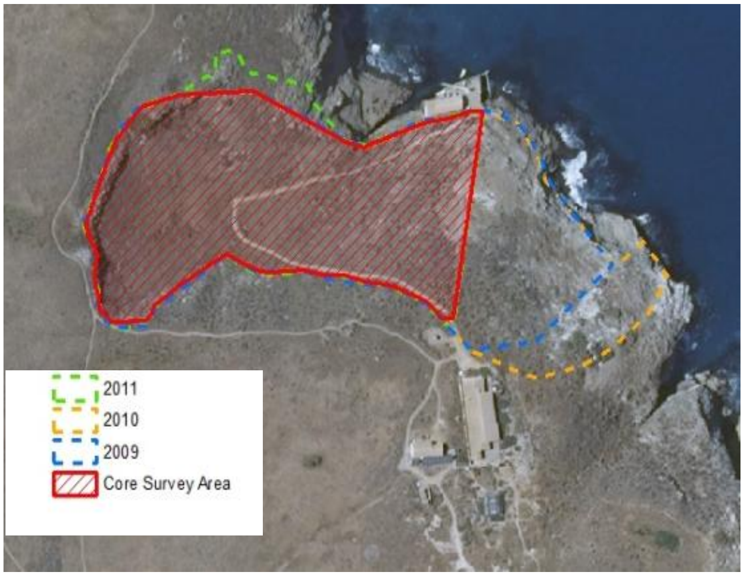

Figure 10. Landing Cove plot boundaries in 2009-2011 and core sampling area monitored annually in 2009-2011. See text for details.

Table 11. Scripps's Murrelet clutch success (CS) at land-based plots in 2010 and 2011.

	2010		**2011**	
Monitoring Plot	**CS**	***n***	**CS**	***n***
Dock	71%	*24*	82%	17
Landing Cove	82%	*60*	64%	14
House	71%	*17*	69%	16
Cat Canyon	68%	*59*	62%	47
West Cliffs	52%	*33*	nd	nd
Boxthorn	79%	*29*	nd	nd
Arch Point North Cliffs	66%	*35*	65%	26
Overall Clutch Success	**70%**	***257***	**68%**	***120***

Table 12. Scripps's Murrelet island-wide egg productivity (EP) in 2010 and 2011. nd=no data.

	2010		2011	
Monitoring Plot	**EP**	***n***	**EP**	***n***
Dock	65%	*40*	74%	*35*
House	76%	*107*	60%	*25*
Landing Cove	69%	*29*	57%	*28*
Cat Canyon	58%	*110*	54%	*85*
West Cliffs	47%	*49*	nd	nd
Boxthorn	73%	*51*	nd	nd
Arch Point North Cliffs	68%	*56*	66%	*41*
Overall Egg Productivity	**65%**	***442***	**63%**	***215***

Table 13. Nest occupancy and reproductive success at long-term monitoring areas on Santa Barbara Island in 2010.

				Cat Canyon	
2010 Nesting Activity	**Dock**	**LACO**	**House**	***Historic***	**All sites**
Total Active Sites	21	47	14	*31 (63)*	46
2010 Clutch Success[1] (n)	71% (24)	82% (60)	71% (17)	*66% (41)*	68% (59)
Egg Productivity[2] (n)	65% (40)	76% (107)	69% (29)	*56% (84)*	58% (110)
% Multiple Attempts (#)	19% (4)	28% (13)	29% (4)	*41% (14)*	37% (17)
Depredation Rate[3] (n)	3% (40)	3% (107)	3% (29)	*33% (84)*	33% (110)

[1] Clutch Success as number of clutches that hatch at least one chick
[2] Egg Productivity as number of eggs hatched per egg laid
[3] Depredation Rate as number of eggs depredated per eggs laid

Table 14. Scripps's Murrelet nest density and reproductive success at expanded monitoring areas on Santa Barbara Island in 2010-11. West Cliffs and Boxthorn were not monitored in 2011; see text for details.

	W.Cliffs	Boxthorn	Arch Point North Cliffs	
Nesting Activity	**2010**	**2010**	**2010**	**2011**
Total Active Sites	25	25	27	22
Clutch Success[1] (n)	52% (33)	79% (29)	66% (35)	65% (26)
Egg Productivity[2] (n)	47% (49)	73% (51)	68% (56)	66% (41)
% Multiple Attempts (#)	52% (13)	16% (4)	44% (12)	23% (5)
Depredation Rate[3] (n)	41% (49)	0 % (51)	13% (56)	15% (41)

[1] Clutch Success as number of clutches that hatch at least one chick
[2] Egg Productivity as number of eggs hatched per egg laid
[3] Depredation Rate as number of eggs depredated per eggs laid

Table 15. Nest site occupancy and reproductive success at long-term monitoring areas on Santa Barbara Island in 2011.

Nesting Activity	Dock Area	Landing Cove	House Area	Cat Canyon *Historic*	Cat Canyon All sites
Total Active Sites	16	12	15	*26 (61)*	39
2011 Clutch Success[1] (n)	82% (17)	64% (14)	69% (16)	*57% (30)*	62% (47)
Egg Productivity[2] (n)	74% (35)	60% (25)	57% (28)	*47% (58)*	54% (85)
% Multiple Attempts (#)	13% (2)	17% (2)	7% (1)	*27% (7)*	28% (11)
Depredation Rate[3] (n)	0 % (35)	0 % (25)	7% (28)	*32% (58)*	27% (85)

[1] Clutch Success as number of pairs that hatch at least one chick

[2] Egg Productivity as number of eggs hatched per egg laid

[3] Depredation Rate as number of eggs depredated per eggs laid

Expanded monitoring areas: West Cliffs, Boxthorn Patch, and Arch Point North Cliffs. In 2010, the additional three monitoring plots (WC, APNC, and BT) yielded data from 77 individual nest sites that have not been routinely monitored in previous years (although some prior data exist for the APNC plot; see Whitworth et al. 2003, 2011). The WC and APNC plots were comprised almost entirely of rocky crevice habitat, while the BT plot was so named for the Boxthorn (*Lycium californicum*) patch of which the plot is entirely comprised (see below for nest site characteristics).

We monitored 25 active nests in the West Cliffs plot in 2010 (see Whitworth et al. 2011 for additional discussion of expanded plot monitoring in 2009-2010, conducted as part of a larger project; Table 14). A total of 38 clutches (25 first, 12 second, and 2 third) were laid in these sites during the 2010 breeding season. Clutch success at West Cliffs in 2010 was 52% (n=35 clutches), and egg productivity 0.47 (n=49 eggs). We did not monitor the West Cliffs plot in 2011. In the Boxthorn Patch plot, we recorded a total of 29 clutches in 25 active sites in 2010. Reproductive success was high, with CS=79% (n=29) and EP at 0.73 (n=51). We did not monitor the Boxthorn plot in 2011.

The APNC plot had a total of 39 clutches laid in 27 nest sites in 2010 (for comparison, in 2009, 28 sites were active in the same search area, reported in Whitworth et al. 2011). In 2010, clutch success was 66% (n=35), and egg productivity was 0.68 (n=56 eggs). Reproductive success in the following year did not change substantially, but there was a 19% drop in the number of active nest sites (5 fewer in 2011 than in 2010).

SCMU egg fates in 2010-2011. In 2010, we determined fates for a total of 446 eggs from 205 nest sites (Table 16). Island-wide egg productivity was 65% (eggs hatched per eggs laid). Of the remaining 157 eggs, most were either depredated by mice (68), abandoned (34), addled (22), or disappeared (23). In 2011, we assigned fates to 218 eggs from 104 nest sites. Island-wide egg productivity was 59%. Of the remaining 88 eggs, most were either depredated (31), abandoned (20), addled (11) or disappeared (10). The island-wide mouse egg depredation rate (eggs depredated/eggs laid) was calculated at 15% in 2010 and 14% in 2011. As in past years, Cat Canyon had higher depredation rates than the other regularly monitored plots. APNC and WC also had high depredation rates, while observed depredation in LC, DO, BH, and BT plots was negligible.

Table 16. Scripps's Murrelet egg fates from all monitored plots in 2010-2011. Failure categories in italics are a subset of total eggs failed.

Egg Fates (all plots combined)	2010	2011
Hatch	289	130
Fail	157	88
Depredated(mouse)	*68*	*31*
Abandoned	*34*	*20*
Addled	*22*	*11*
Broken	*6*	*5*
Chick died in nest	*2*	*3*
Disappeared	*23*	*10*
Kicked Out	*2*	*8*
Total n (known fates)	**446**	**218**

Abandonment rates were similar in both years (8% and 9% of eggs laid in 2010 and 2011, respectively). Abandonment rates were highest in Landing Cove, Boxthorn, and House plots. Of note, these plots experienced the least amount of egg depredation by mice, but adult murrelet carcasses were more frequently found in these areas; we suspect that increased nest abandonment rates may reflect adult mortality (see below).

Table 17. Total and percent eggs depredated in each monitoring plot in 2010 and 2011. See text for details.

Plot	2010 (total)	2011 (total)	2010 (percent)	2011 (percent)
Cat Canyon	36	23	33%	56%
West Cliffs	20	nd	41%	nd
Arch Point North Cliffs	7	6	11%	43%
Landing Cove	3	0	3%	0%
Dock	1	0	3%	0%
House	1	2	4%	15%
Boxthorn Patch	0	nd	0%	nd
Totals	**68**	**31**	**15%**	**14%**

Multiple SCMU clutches in discrete nest sites. In 2010-2011, all SCMU plots continued to exhibit a greater than one ratio of clutches laid per nest site ("CPS" statistic; Figure 11, Table 18; see Whitworth et al. 2011, Harvey et al. 2012 for discussion). This statistic showed a general decrease after a notable peak in 2009 (Harvey et al. 2012). The only exception to this emerging trend was a slight increase at the LACO plot from 2009 to 2010, followed by a decrease similar to the rate for other plots with available data from both 2010 and 2011.

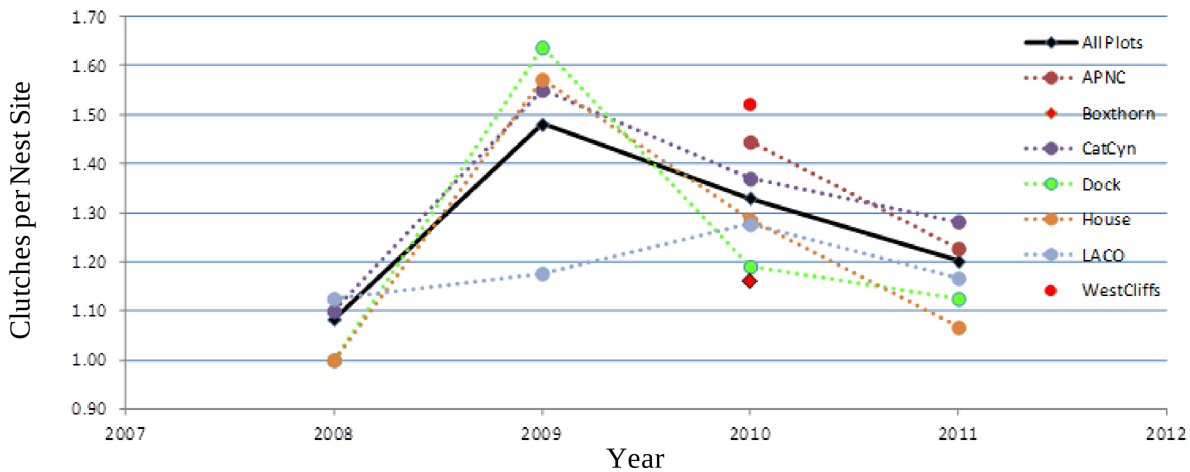

Figure 11. Total proportion of Scripps's Murrelet clutches laid per active site at plots monitored in 2008-2011. See above for sample sizes; 2008-2009 data reproduced from Harvey et al (2012).

Table 18. Summary of total Scripps's Murrelet multiple clutches relative to individual nest sites in Santa Barbara Island monitoring plots, 2008-2011. 2008-2009 data reproduced from Harvey et al (2012).

Year	**2008**		**2009**		**2010**		**2011**	
SBI Plot	***Active Sites***	**Total Clutches**	***Active Sites***	**Total Clutches**	***Active Sites***	**Total Clutches**	***Active Sites***	**Total Clutches**
Dock	*7*	7	*11*	18	*21*	25	*16*	18
House	*5*	5	*7*	11	*14*	18	*15*	16
Landing Cove	*8*	9	*17*	20	*47*	60	*12*	14
Cat Canyon	*40*	44	*40*	62	*46*	63	*39*	50
West Cliffs*	*nd*	nd	*Reported in Whitworth et al. 2011*		*25*	38	*nd*	nd
Boxthorn*	*nd*	nd			*25*	29	*nd*	nd
Arch Point *	*nd*	nd			*27*	39	*22*	27
Totals	***60***	**65**	***75***	**111**	***205***	**272**	***104***	**125**

**WC, BT, and APNC results in 2009-2010 are also reported in Whitworth et al. 2011*

Comparison of basic SCMU nest monitoring to extended surveys. The expanded monitoring effort that we undertook in 2010, and to a lesser extent 2011, provided much increased (more than double) nest sample sizes from a greater proportion of the island with which to assess efficacy of previous monitoring schedules and to provide recommendations for future monitoring effort. For preliminary analyses herein, we used data from the largest available sampling year (2010) and clutch success as the reproductive estimate. Clutch success from (1) long-term, "basic" study plots only (the Northeastern plots and Cat Canyon combined; see above section for details) was 73%; from "expanded" restoration plots only (WC, APNC, and BT plots) was 66%, for (3) an island-wide combined clutch success of 70%. Clutch success between basic study plots and the expanded monitoring plots did not differ statistically ($P<0.05$).

SCMU reproductive success and timing of first versus sequential clutches. We examined clutch success for first versus second and (rarely) third clutches laid in the 2010 nesting season (Table 19). First clutches outperformed second and third clutches by a wide margin at all monitored areas, and while sample sizes differ, they appear to be adequate for this basic comparison. Island-wide, clutch success for first attempts was 78% (n=192) versus just 40% (n=63) for second attempts. At Cat Canyon, 47% (n=17) of second clutches versus 76% (n=42) of first clutches succeeded. Most (70%; n=63 sites with 2 clutches each and fates known for each) second clutches were laid after the first clutch of the season succeeded. Additionally, most of the second clutches that ultimately succeeded (18/25) did so after the first clutch had already successfully hatched.

Table 19. Scripps's Murrelet reproductive success (CS) of first versus sequential clutches in 2010.

Plot	1st (n)	2nd (n)	3rd (n)	Total
Cat Canyon	76% (42)	47% (17)	none laid	68% (59)
Bunkhouse	85% (13)	25% (4)	none laid	71 % (17)
Landing Cove	85 % (47)	67% (12)	100% (1)	82 % (60)
Dock	80% (20)	25% (4)	none laid	71% (24)
APNC	74% (23)	50% (12)	none laid	66% (35)
West Cliffs	55% (22)	40% (10)	100% (1)	52% (33)
Boxthorn	88% (25)	25% (4)	none laid	79% (29)
All plots:	**78% (192)**	**40% (63)**	**100% (2)**	**70% (257)**

Other species nesting in SCMU monitoring plots: CAAU, ASSP, and PIGU.

Arch Point North Cliffs

Cassin's Auklet. In 2010, two CAAU nests (#1303, A6) were active in APNC, each of which had two clutches. Site 1303 held an adult incubating on 9 February; this egg hatched in late

March, and the chick departed the nest between 4/16 and 4/19. A second egg was laid between 4/19 and 4/30; the chick departed between 7/26 and 8/9. The first clutch in site A6, which held a chick on the day the site was discovered (5 April), ultimately failed. A second attempt was initiated in late May; the egg hatched in mid to late June, and the chick apparently fledged in early to mid August. In summary, 75% of known CAAU attempts (n=4) fledged a chick at APNC in 2010.

In 2011, three CAAU nests were potentially active in APNC (#1303, 1333, 1337). However, we could only confirm egg laying in one site (#1303), which ultimately hosted 2 attempts. The first survey on 4 March found an adult with egg, which hatched in early April and fledged in mid to late May. A second egg was laid in this site in early Jun, hatched in early July, and ultimately fledged in late August. In summary, 100% of known CAAU attempts (n=2) fledged a chick at APNC in 2011. Note that site #1303, found on SBI in 2009, was the first confirmed CAAU nest since 1994 (Whitworth et al. 2011).

Ashy Storm-Petrel. We discovered 7 active ASSP nests in the APNC plot in 2010. Egg-laying was confirmed in 6 of the sites, but we were able to determine fledging rate for just 4 nests. Three sites fledged one chick each; the fourth failed due to egg depredation. The earliest nest attendance was noted on 19 March (2 adults in site); the first egg was observed on 2 April 2010; we estimated that two of the sites fledged chicks in mid to late September, and the third site fledged a chick in mid August.

In 2011 we monitored 5 active ASSP nest sites in the APNC plot (2 of the nest sites that had been monitored in 2010 were excluded in 2011 due to safety concerns related to proximity to a precipitous cliff edge). We confirmed egg-laying in 4 of 5 sites. At least two of these sites were successful (each fledged one chick); the third and fourth were likely also successful, with small gawky and medium gawky chicks observed on the final nest checks (see McIver et al. 2011 for discussion). The earliest site attendance was seen on 4 March (1 adult in site); eggs (1 per site) hatched in early to late July, and a fully feathered chick was still present during the final check of the season (on 9 September).

Pigeon Guillemot. In 2011 at APNC we discovered one PIGU nest site (#1338) which contained two eggs on the nest check on 10 June; however, both failed to hatch.

Scripps's Murrelet and Cassin's Auklet nesting in plant restoration areas. In 2010-2011, we continued native plant habitat restoration, bringing the 2007-2011 total outplanting numbers to approximately 15,495 plants in five main plots and 6 additional areas: Northeast Flats (NEF), Landing Cove (LC), Prohibition Point (PP), Elephant Seal Cove Cliffs (ESC), Beacon Hill (BHP), 5 additional small "Sage Plots", and most recently, Nursery and Housing Areas, comprising over 4.5 acres (Figure 1). We installed artificial nest burrows (N=100) in five locales within three of the main restoration plots: ESC (n=1 cluster of 20 burrows), NEF (n=1 cluster of 20), and LC plots (n=3 clusters of 20 each) in 2009-2011 to facilitate Cassin's Auklet recolonization into restoration areas. No nests were initiated in artificial habitat at the Upper LACO, NEF, or ESC condos in 2010-2011.

No CAAU or SCMU nesting was present in restoration plot areas (caveat: see above for Landing Cove description) during baseline, pre-restoration searches conducted in 2007-2008 (Whitworth et al. 2009B, Harvey and Barnes 2009 and this paper). Nesting reported in this section therefore is an early sign of restoration success. SCMU nesting had not yet occurred in native shrub habitat outplanted in 2007-2011 in the restoration plots, but other nest site types newly occupied in restoration areas in 2010-2011 are described below.

Elephant Seal Cove Cliffs

Scripps's Murrelet. In 2010, at the Elephant Seal Cove Cliffs (ESC) restoration area, one murrelet nest site (A2) was active, with two clutches (2 eggs each) laid over the course of the breeding season (Figure 12). Both clutches were successful (CS=100%; n=2). Egg productivity was estimated at 100% (n=3; fate was not determined for the fourth egg). A2 is a rocky crevice site that had previously been obscured by abundant Crystalline Iceplant (*Mesembryanthemum crystallinum*; MECR), which was removed during plant restoration activities. In 2011, the same ESC nest site (A2) was again successful with both eggs of the single clutch hatching. One additional murrelet nest site (A4) was located outside of the ESC restoration plot boundary (CS=1/1, EP=0.5 with n=2 eggs).

Cassin's Auklet. In 2010, one CAAU nest (A1) was active in ESC. An adult was observed on 7 March; the egg was found depredated on 4 April. Like site A2, above, this crevice previously been obscured by MECR. A second clutch was laid in late April and hatched in early June; but was not observed after June 26; the chick presumably did not fledge.

In 2011, two CAAU nests (A1, A3), both successful, were documented in rocky crevices in the ESC restoration plot (both of which had previously been obscured by MECR, as with site A2 above). Site A1 was already occupied (one adult) by our first survey on 19 March; the egg hatched in late April, and the chick fledged in early June. A second attempt was initiated sometime between 11 June and 4 July, at which time an adult was observed in the nest, but we were unable to determine its outcome. In site A3, an adult was also present during our first survey on 19 March; the egg hatched around 1 May and the chick departed the nest between 31 May and 11 June.

Figure 12. Overview of the southwestern aspect of the Elephant Seal Cove Cliffs plot prior to restoration. Note extensive cover of Crystalline Iceplant. 10 February 2009. Photo A.L. Harvey.

Landing Cove. The Landing Cove restoration plot overlaps the murrelet monitoring plot described above (see below for plot area standardization information; Figure 13). As of 2011, murrelets had not expanded into the *additional* shrub habitat installed (versus already present; see LC monitoring results, above, and active nest site characteristics, below). However, most shrubs planted in 2007-2010 were not yet large enough by the 2011 murrelet nesting season to support new nests.

CAAU restoration: artificial burrows and social attraction. As noted above, we installed 20 artificial nest burrows (“AB”) designed for CAAU using the model developed for the Scorpion Rock colony (Adams et al. 2009) in 2009 (“upper” LACO condos), 20 ABs in the NEF plot (above LACO), and 20 in the ESC restoration plot. We commenced social attraction (design: S. Schubel, murremaid.com) prior to the 2010 nesting season on 14 December 2009 with speakers at two locations: “middle LACO condos” and “NEF burrows”. No CAAU nesting was documented in any artificial habitat in the following (2010) breeding season.

Figure 13. Overview photo of the southeast corner of the Landing Cove plot, 8 February 2009 (left, prior to restoration; photo A.L. Harvey) and 16 February 2013 (right, after four years of restoration; photo C.A. Carter).

Assessing Barn Owl (*Tyto alba*; BNOW) activity relative to social attraction and artificial habitat. In preparation for the 2011 breeding season, and in response to adult CAAU mortality observed in 2010 near the social attraction equipment (Thomsen and Harvey 2012), we installed an additional 40 new artificial burrows in Landing Cove during the 2010 post-breeding season (fall 2010) on SBI in two separate clusters ("condos"): one in upper Landing Cove about 10m above the trail bench and one in lower Landing Cove on the north side of the trail. We also redesigned the artificial habitat areas and speaker array and moved speakers from upper LACO and NEF to middle and lower LACO in response to observed predation, presumably by BNOWs, near the broadcast speakers in 2010 (Figure 15). Concurrently, we installed Reconyx infrared motion detector cameras at the new LACO artificial habitat “condos” (LLC and MLC, where broadcast speakers were located) to document (a) any new auklet nesting activity and (b) to monitor BNOW activity in the restoration area.

We conducted observational studies of the LACO plot at dusk (when owls typically begin foraging) coupled with remote camera monitoring to assess BNOW presence and activity before and after new habitat construction and before and after vocalization playback implementation (remote cameras were set for continuous 24-hour motion detection; Tables 20, 21 and Appendix 6). We first commenced auklet broadcast playback at a limited (90 minute) duration starting at dusk, coupled with observers and cameras, to assess whether owl activity or abundance changed in response to auklet vocalizations. To minimize the likelihood of attracting owls by our presence, we did not use lights to search for owls.

Table 20. Details of observer surveys to assess Barn Owl presence and activity around the Landing Cove artificial habitat and social attraction in 2011.

Survey Number	Survey Date	Start Time	End Time	Social Attraction/Habitat Status
1	1/16/2011	1750	1900	Pre-habitat modification survey.
2	1/20/2011	1745	1845	20-22 Jan: Modify artificial habitat.
3	1/21/2011	1743	1848	20-22 Jan: Modify artificial habitat.
4	1/26/2011	1750	1845	1/26 set up reconyx cameras.
5	1/29/2011	1740	1842	1/29 begin limited broadcasts: 90 min starting at
6	1/30/2011	1745	1840	dusk.
7	2/1/2011	1800	1900	Continue limited broadcasts.
8	2/4/2011	1750	1906	Continue limited broadcasts.
9	2/7/2011	1750	1850	Continue limited broadcasts.
10	2/8/2011	1750	1853	Continue limited broadcasts.
11	2/10/2011	1805	1859	Continue limited broadcasts.
12	2/14/2011	1808	1908	Continue limited broadcasts.
13	2/15/2011	1805	1907	Continue limited broadcasts.
14	2/20/2011	1757	1859	Begin dusk to dawn broadcasting.
15	2/22/2011	1805	1905	Dusk to Dawn broadcasting.
16	2/26/2011	1805	1905	Dusk to Dawn broadcasting.
17	2/27/2011	1810	1910	Dusk to Dawn broadcasting.
18	3/1/2011	1815	1916	Dusk to Dawn broadcasting.

The 18 surveys conducted resulted in no indication of (1) unusual BNOW presence in LACO (maximum one to two birds per “dusk survey”) or (2) altered occurrence or behavior before, during, or after artificial habitat construction or social attraction. However, we suspected that owls could be attracted to our presence, and switched to remote camera monitoring without observer presence after 1 March. We began dusk to dawn broadcasting after noting no change in owl activity or abundance in response to the broadcast vocalization.

We discontinued visual surveys after 1 March but continued to check images from the two Reconyx cameras approximately daily through June and periodically thereafter until cameras were removed on 11 August (see Appendix 6). We also searched habitat on foot at regular intervals (described above). BNOW images were captured on: 1 May, 23 May; 12 June; 16 June; 22 June;15 July; 31 July. On 20 May 2011 we discovered a CAAU carcass in LACO near the artificial habitat. Camera documentation of CAAU attending the LACO condos is described below. We conducted the LACO observations in conjunction with the larger BNOW study (Thomsen and Harvey 2012, Thomsen et al. in prep). These concurrent studies found no indication that BNOW were present in unusual numbers or were being attracted to the artificial habitat/social attraction area, either before, during or after early habitat construction or nocturnal broadcast.

Table 21. Results of observer surveys to assess Barn Owl presence and activity around the Landing Cove artificial habitat and social attraction system in 2011.

Survey Number	Survey Date	Barn Owl Detections	Other Notes
1	1/16/2011	1 vocalizing: fly over LACO several times and then towards Arch Point	1-2 Burrowing Owls heard (flying by)
2	1/20/2011	1 vocalizing: fly over LACO towards Arch Point	1 Burrowing Owl heard (flying by)
3	1/21/2011	1 vocalization from upper Landing Cove	
4	1/26/2011	1 fly over and then perch in COGI below kiosk area (housing area).	Possibly attracted to observers.
5	1/29/2011	2 vocalizations: 1 faint (from housing area); 1 fly over LACO and return to housing. Probably the same bird.	
6	1/30/2011	No detections	Poor (windy) survey conditions.
7	2/1/2011	No detections	
8	2/4/2011	1 bird (most likely) flying between LACO and housing area for approximately 25 minutes	18:41-19:05 hours
9	2/7/2011	No detections	
10	2/8/2011	1 vocalization high overhead; flew toward housing	
11	2/10/2011	No detections	1 Burrowing Owl heard (flying by)
12	2/14/2011	No detections	
13	2/15/2011	No detections	
14	2/20/2011	No detections	
15	2/22/2011	2 vocalizations flying between house and LACO	Both observations occurred when observer turned on flashlight.
16	2/26/2011	1 flew past observation point	
17	2/27/2011	No detections	
18	3/1/2011	1 faint vocalization	1 Burrowing Owl heard (flying by)

CAAU and SCMU nesting activity in LACO "condos" area. In 2011, we detected the first sign of CAAU prospecting activity near the lower speaker (a natural burrow excavation noted during diurnal habitat search) in late January (26th). In contrast, camera monitoring first documented CAAU prospecting near the broadcast speakers on 28 February (Figure 15, 16; Appendix 6). Camera data indicated that prospecting continued on most nights through March; images were typically captured between 20:00 and 06:00 hours. The first confirmed nesting in the LACO artificial habitat was documented on 5 April 2011.

In 2011, using remote camera as well as traditional (visual) monitoring, we documented a maximum of 16 potential CAAU sites (2 in MLC and 14 in LLC), including four natural burrows or burrow starts in the Lower LACO condos near (less than 1.5 meters from) the lowest speaker location (Figure 16). Egg-laying was confirmed in 7 sites (6 artificial burrows and 1 natural burrow). 57% of eggs laid hatched (n=7), but only one chick was confirmed as fledging. This chick was banded on 22 June (USGS band #1313-46124). Earliest egg-laying occurred in early April in 2011. Cassin's Auklet carcasses were recorded in Landing Cove as encountered.

In 2011, the Lower Landing Cove artificial burrows (designed for CAAU and described above) also hosted two SCMU nests in (LLC #10 and #12). Each nest contained one egg, both of which failed (CS=0 with n=2 clutches; EP=0 with n=2 eggs), possibly due to interspecific competition with CAAU which were apparently prospecting in the same nest sites after SCMU began nesting there (i.e. evidence of digging/guano).

Since we did not attempt to confine nesting birds to ABs (our primary goal was colony establishment vs. nest monitoring sample), CAAU dug tunnels between discrete ABs in 2011. This created uncertainty in determining the ultimate number of total active nests as well as nest fates. To correct our inability to accurately assess CAAU nest fates, we purchased a burrow scope ("Pukumanu") in January 2012 for use in subsequent breeding seasons.

As an interesting note, in 2011 (April), we also documented one Orange-crowned Warbler (*Vermivora celata sordida*) nest in an Island Sage (*Artemisia nesiotica*) shrub we had planted in the LACO restoration plot.

Figure 14. Nocturnal Reconyx image of a Cassin's Auklet in an artificial burrow entrance in the Landing Cove restoration plot.

Figure 15. Newly installed artificial habitat in the Landing Cove restoration plot with coverboards to provide additional protection from aerial predators, installed in fall 2010. Native outplantings were subsequently added to improve soil stability and increase cover. Photo: A.L. Harvey.

Figure 16. Natural Cassin's Auklet burrow entrance next to the social attraction broadcast speaker in the Lower Landing Cove condos. Photo: A.L. Harvey.

Physical characteristics and success rates of Scripps's Murrelet active nest sites. We collected and archived detailed SCMU site data (nest type, size, geographic location, photographs) annually for use in long-term comparisons. For this report, we summarized active nest sites by type for the 2010 breeding season (the largest nesting sample available). Nest sites in the Cat Canyon, West Cliffs, and Arch Point North Cliffs plots were all located primarily in rocky crevice habitat (Table 22). The Landing Cove and Boxthorn plots were comprised primarily of native shrub habitat including the following species: Santa Barbara Island Buckwheat (*Eriogonum giganteum compactum*; ERGC), Prickly Pear (*Opuntia littoralis*, OPLI), Giant Coreopsis (*Coreopsis gigantea*, COGI), Silverlace (*Constancea nevinii* formerly *Eriophyllum nevinii*; CONE), Island Tarweed (*Deinandra clementina*, formerly *Hemizonia clementina*; DECL), Sea-blite (*Sueada taxifolia*, SUTA), Boxthorn (*Lycium californicum*, LYCA), and Island Sage (*Artemisia nesiotica*, ARNE). In Landing Cove, several active nests also were located under old BRPE nests. Most nests in both the House and Dock plots were associated with artificial structures.

Table 22. Active Scripps's Murrelet nest site characteristics at eight monitoring locations on Santa Barbara Island in 2010.

Site Type	LC	CC	DO	BH	WC	BT	APNC	ESC
Rock Crevice	1	42	1		25		27	1
Artificial Nest Box			7					
Artificial Nest Burrow								
Manmade structure, other			13	10				
BRPE nest	3							
Native Shrub	43	4		4		25		
BRPE nest/ERGC	*3*							
BRPE nest/ERGC/OPLI	*1*							
COGI/ERGC	*1*							
CONE	*6*							
CONE/ERGC	*1*			*2*				
DECL	*5*							
ERGC	*26*	*1*						
SUTA				*1*				
SUTA/ARNE				*1*				
LYCA		*3*				*25*		
TOTAL ACTIVE SITES	**47**	**46**	**21**	**14**	**25**	**25**	**27**	**1**

To control for unknown factors that relate to multiple clutches per site (see above) we examined reproductive success for first clutches only to determine whether an obvious site type signal was present. We calculated first clutch success by site type to determine if differences in reproductive success were apparent (Table 23). The highest success rate in 2010 (87%) was associated with native shrubs and the lowest with the few BRPE nests in the sample (67%); and rock crevices (70%).

First eggs are far more frequently depredated (during the neglect period) than second eggs (Harvey et al. 2009, 2012, this paper); we calculated egg productivity (hatching rate) of the first egg laid (of each first clutch) to determine if a broad pattern by site type was present (Table 24). Egg productivity in 2010 was highest in native shrubs (80%; n=71 first eggs), lowest in the small BRPE nest sample (50%; n=3 first eggs), and very low in the rocky crevice category (57%; n=97). We caution that site type is strongly related to plot location; further analysis is needed to determine its relationship to nest success as well as to detect any spatial (or other) biases in estimates of reproductive success using site type as a predictor variable. We therefore did not attempt formal statistical analysis for this preliminary work.

Table 23. Scripps's Murrelet first clutch success rates by nest site type in 2010. See text for sample sizes.

Site Type	APNC	BH	BT	CC	DO	ESC	LC	WC	Total
Artificial Nest Box					86%				86%
BRPE Nest							67%		67%
Manmade (other)		89%			75%				81%
Rock Crevice	74%			74%	100%	100%	100%	55%	70%
Shrub		75%	88%	100%			87%		87%
Shrub/BRPEN							80%		80%
Total	**74%**	**85%**	**88%**	**76%**	**80%**	**100%**	**85%**	**55%**	**78%**

Table 24. Egg Productivity of first eggs by nest site type at Santa Barbara Island in 2010.

Site Type	First Egg Productivity (First Clutches only)	n
Artificial Nest Box	57%	7
BRPE Nest	50%	3
Manmade (other)	67%	23
Rock Crevice	57%	97
Shrub	80%	71
Shrub/BRPE Nest	70%	5
Total	**66%**	**206***

*In 2010, we monitored 205 nest sites in standardized plots plus one in the ESC restoration plot.

SCMU at-sea captures and banding. Results of capture efforts at SBI in 2010, including band details, are reported in Whitworth et al. (2011). In summary, in 2010 a total of 125 murrelets were banded and a total of 131 birds captured in six capture nights (15-16 March; 3, 10, and 30 May, 1 June). With limited capture effort expended in 2011, we captured just 23 birds in that year, including two recaptures of birds banded at SBI in previous years (April 2009 and May 2010; Whitworth et al. 2011; Appendix 7). Two additional SCMU were captured but released without bands (one due to abnormally large tarsi, and one not banded because it was a one-legged bird). Three captured birds had partial or complete brood patches. No Guadalupe Murrelets (*Synthliboramphus hypoleucus*) were seen or heard in 2011.

Avian predators on SBI. Barn Owls were resident and nesting in 2010-2011; their abundance and activity as well as carcass data from monitoring plots reported herein are reported in Thomsen and Harvey (2012) and Thomsen et al. (2013). Peregrine Falcons (*Falco peregrinus anatum*, PEFA) were present, and while dedicated surveys were not performed for this species in 2010-2011, at least one pair probably nested in both years in the aerie below Signal Peak as in 2007 (see Latta 2012). No Common Ravens (*Corvus corax*) or Bald Eagles (*Haliaeetus leucocephalus*) were noted on SBI in either year. Burrowing Owls (*Athene cunicularia*) were occasionally observed, but nests were not documented and individuals were not noted in the Cat Canyon murrelet plot during the breeding season as has occasionally been documented in previous years (Harvey and Barnes 2009). At least one pair of American Kestrels (*Falco sparverius*, AMKE) bred on SBI in the Landing Cove area each year. AMKE were frequently observed harassing PEFA in the housing and Landing Cove areas during their breeding seasons. The Santa Barbara Natural History Museum (P. Collins) maintains a complete list of the avifauna of the Channel Islands.

DISCUSSION

SBI provides critical habitat for multiple species of breeding seabirds; the native plant habitat restoration project funded by the Montrose Settlements Restoration Program seeks to improve breeding conditions for Scripps's Murrelets and Cassin's Auklets by restoring perennial shrub communities on the island (MSRP 2005, 2012, Harvey and Barnes 2009, Whitworth et al. 2009b, Whitworth et al. 2011, Harvey et al. 2012). In this report, we focused on generating recommendations from the seabird monitoring component of the program, which is designed to gather information regarding the reproductive success of SCMU and CAAU during project implementation.

Scripps's Murrelet productivity statistics.

A major goal of this study was to assess the efficacy of current and past monitoring efforts for SCMU on SBI and to provide recommendations for long-term monitoring strategies that balance information content with effort expenditure. For the SCMU, we monitored a total of 272 clutches in 205 nest sites in 2010 and 125 clutches in 104 nest sites in 2011. Island-wide (all plots combined) reproductive success was quite high in both years; clutch success was 70% and 68% in 2010 and 2011, respectively. Egg productivity rates were 65% and 63% in 2010 and 2011, respectively.

Previous researchers have discussed the need for a standardized statistic with which to: (a) compare reproductive success among colonies and (b) compare contemporary (i.e. 2007-2011) nest monitoring results on SBI with those reported in previous years (e.g. Carter et al. 2011, Harvey and Barnes 2009, Harvey et al. 2012). The most commonly used productivity statistic, fledging rate, is not possible for the SCMU because chicks depart the nest at approximately 2 days of age; breeding success for the species is therefore reported variously as egg productivity and the similar "hatching success" or "clutch success" statistic. Uncertainty levels in the clutch success statistic arise from the following: a) it is unknown whether SCMU are able to lay more than one clutch per year, b) occurrence of intra-specific nest site competition (i.e. use of a single nest site by multiple pairs, either concurrently ("usurping") or sequentially may bias per-pair estimates of success, and c) egg loss rates due to deer mouse depredation are very high. Because of these factors, in 2007-2009 reported statistics included: (1) an estimate of productivity as number of eggs hatched per number of eggs laid with known fates; (2) hatching success per unique nest site, regardless of number of clutches ultimately laid in the site; and (3) hatching success per clutch (Harvey and Barnes 2009, Harvey et al. 2012).

In 2010-2011, we incorporated new information gathered from nest cameras installed in selected nest sites on SBI. While data from this study have not been fully analyzed, the following observations are relevant to the discussion of individual pair use of discrete nest sites. Intra-specific competition was apparent, and observations of aggressive interactions between pairs during the egg laying and incubation periods provided evidence that sites containing more than two eggs were most likely indicative of site use by more than one pair, as previously speculated. As a result, in 2010 data analysis, we added the "usurped" category to egg fate classification coding to indicate failures due to observed intraspecific competition. More work is needed to retroactively analyze nest monitoring data, particularly with respect to the apparent increase in sites with multiple attempts (i.e. the CPS statistic reported herein), which may indicate increasing levels of competition for suitable nesting habitat.

In terms of long-term comparability of the SBI reproductive data, traditional plot-based nest monitoring on SBI (i.e. nest density recorded in standardized areas that do not vary from year to year) is also problematic in some years. For example, the long-term CINP monitoring plot "Nature Trail" has not been consistently monitored due to frequent BRPE nesting since 2006. Additionally, the long-term plot "Cat Canyon" at the southern end of the island was apparently not thoroughly searched in all monitoring years; rather, reproductive data were gathered only from previously tagged sites representing a subset of available habitat. Similarly, the boundaries of our newly established "Landing Cove" plot will likely continue to change from year to year with shifts in BRPE nesting density and locales. Because of these issues, many researchers have advised caution regarding attempts to use land-based nest monitoring to infer trends in nesting density as it relates to colony size. However, by annually searching all potential habitat within each plot and accurately documenting nest locations within plot boundaries, we expect to be able to better assess changes in nesting density within plots in future years. This will be especially important as available shrub habitat increases in restoration plots throughout the island. Additionally, if the multiple clutch per site statistic does reflect multiple pairs competing for limited space, it may also ultimately help inform our understanding of colony dynamics by providing a metric that indicates recruitment to areas with limited available habitat.

Reproductive success information from expanded surveys and estimated sampling proportions using land-based plot monitoring.
Using median values for both the Whitworth et al. (2011) population estimate and for the nesting samples (median of total clutches and total nest sites) in both years indicates that we sampled approximately 50% of the colony in 2010 and approximately 24% in 2011. We found that data from long-term plots slightly overestimated island-wide reproductive success compared to the new plots (CS=73% versus 66%, respectively), but this difference was not statistically significant. In other words, island-wide results from the 2010 monitoring data using our basic survey strategy would have been reported at 73% versus the 70% reported here. More work is needed to statistically describe results of this study, examine the results of the Egg Productivity and Egg Depredation metrics, and explore the data for spatial and habitat-level (site type) differences. Statistical modeling work is beyond the scope of this document, but is being incorporated into a larger forthcoming study of the SBI system (Nur et al. in prep.).

Ashy, Black, and Leach's Storm-Petrels. Of the three species of storm-petrel that occur on SBI, ASSP are the most abundant; however, only relatively small numbers of ASSP have been captured in mist-nets on SBI since 1978 (Hunt et al. 1980, Carter et al. 1992, Feldman and Sydeman 1995, Shultz and Sydeman 1996, Roth et al. 1997, Martin and Sydeman 1998, Wolf et al. 2000, Ainley 1995, J. Adams unpubl. data, H. Carter, A. Harvey unpubl. data, this study). We have not documented the Leach's Storm-Petrel in mist-nets or otherwise from 2009-present, and it is unknown whether they currently breed on SBI. Black Storm-Petrels were also discovered to be breeding (on Sutil Island) during the Hunt et al. (1980) study, and small numbers have been captured in mist-nets since that time (Ainley 2008). As with other seabirds on SBI, the BLSP was most likely reduced from historic levels by feral cat predation and other anthropogenic factors (see McChesney and Tershy 1998), but has received little study attention.

Ashy Storm-Petrels are currently proposed for listing under the Endangered Species Act, and the USFWS is in the process of preparing a status review to respond to the petition for listing (USFWS 2012). SBI is now believed to be one of the four largest Ashy Storm-Petrel breeding locations in its range (Carter et al. 2008). Standardized nest monitoring for Ashy Storm-Petrels such as that conducted at Santa Cruz Island (McIver et al. 2013 and references therein) has not been possible at SBI due to the very low sample size that can be accessed from land; small numbers of nests were found in sea caves in 2008, 2009, and 2010 (Whitworth et al. 2009b, 2011). In 2010, we also located a small sample of nests (7) accessible from land in the Arch Point North Cliffs plot. However, most nests were situated in rocky crevices that were too deep to reliably monitor for reproductive success. Similarly, focused studies to determine colony trends have not been attempted, although mark-recapture work has been conducted in some years (see below). In 2010-2011, we allocated a small amount of effort during the restoration project toward increasing the sample of banded individuals at SBI for possible future mark-recapture and demography studies, capturing a total of 105 individuals in the two years.

While methodologies differed to some degree and data must be standardized before formal analysis, a preliminary comparison between the limited efforts in this study and those in 1999 (Wolf et al. 2000) may provide a useful perspective. In 1999, 73 unique ASSP were captured at SBI in 14 hours of net effort, using similar techniques to those employed in the 2010-2011 SBI work. In comparison, the 14 hours of effort expended in 2010 resulted in just 20 new captures. If we convert the raw 1999, 2010, and 2011 captures to an hourly rate (birds captured per hour of effort), 2010 and 2011 capture rates were 73% and 59%, respectively, lower than the 1999 capture rate.

Because of significant variations in capture rates and difficulties in data standardization (see Ainley 1995), this simple numeric comparison is provided only as a very rough characterization of petrel data on SBI. Comparisons have not yet been attempted between 2011 and more extensive mist-net data gathered in 1991 (Carter et al. 1992) or limited mist-net data obtained in other years (see above). Much more work is needed to collate, standardize, and analyze existing mist-net capture data from for its utility in trend analysis. However, there is certainly no indication that the ASSP colony at SBI has increased, and these preliminary comparisons suggest that the colony is likely experiencing a negative trend from the already reduced population that persisted during and after the period of feral cat infestation.

Native plant habitat restoration and native predators. We continue to see evidence that native plant restoration is a valuable long-term restoration strategy for improving seabird breeding conditions on SBI. In 2010, SCMU nest sites located in native plant habitat far outperformed those in rocky crevices: island-wide, clutch success (first clutches only) was 87% from shrub sites (n=77 sites) versus 70% from rocky crevice sites (n=97 sites). Similarly, first egg productivity was highest in native shrubs (80%; n=71 first eggs) and very low in the rocky crevice category (57%; n=97 first eggs). While this is encouraging, the results should be cautiously interpreted because of the potentially confounding spatial factor, which may be related to differences in mouse abundance, owl foraging areas, or other differences in the microhabitats. However, previous researchers also found that longer-term (1993-2002) egg depredation rates were lower in the shrub habitat plot (Nature Trail) than in the rocky crevices of the Cat Canyon plot, although reproductive success was also lower there (Schwemm et al. 2005).

Of note, the Nature Trail plot is adjacent to Barn Owl Cave, a long-term BNOW nesting location where high numbers of SCMU and other seabird carcasses have been documented in various years; adult mortality is likely the cause of decreased reproductive success not attributed to egg depredation (Roth et al. 1999, Wolf et al. 2000, Whitworth et al. 2011, Harvey et al. 2012, Thomsen and Harvey 2012, Thomsen et al. 2013).

As a result of our general finding of heightened reproductive success in shrub habitat, we suggest that in addition to providing increased physical nesting habitat for seabirds, native shrub habitat will ultimately provide a buffer against native deer mouse predation on seabird eggs by supplying a preferred food source for mice, and that this buffer effect may be independent of mouse densities. Mouse population dynamics are related to interannual patterns of rainfall, the timing and extent of which both influence overwinter mouse survival, which is related to spring mouse abundance, and drive annual seed production, the latter of which is related to summer and fall mouse densities (e.g. Schwemm and Coonan 2001). Adequate seasonal precipitation and relative humidity levels throughout the rainy season as measured on a relatively fine scale (versus total or average annual precipitation, which are broad metrics that do not necessarily characterize ideal plant recruitment and/or growth conditions) should therefore result in a healthy mouse population with an adequate seed food source. Native plant seeds, if abundant, presumably are far less energetically expensive forage items than relatively large eggs such as those laid by SCMU. This hypothesis has not been tested statistically, but the data collected during the course of this and previous studies suggest that this may be the case.

Finally, many of the rocky crevice areas used concurrently by mice and murrelets are infested by the exotic and highly invasive succulent Crystalline Iceplant. This South African species was already noted on SBI by the late 1800s (Grinnell 1897), and expanded greatly during the mid-1950s, concurrent with the great reduction in island native plants by introduced rabbits (Sumner 1958). Crystalline iceplant cover now exceeds 90% in some areas. In addition to improving conditions for native plant establishment and recruitment via both physical and chemical release from competition (e.g. Vivrette and Muller 1977, D’Antonio et al. 1992, 2002), reduction of iceplant in seabird nesting areas should eventually improve seabird reproduction by reducing physical exclusion of murrelets and auklets from natural crevice nesting habitat. Iceplant may also provide an unusual amount of resources (i.e. food, water, and cover) for mice (Harvey, pers. obs.). If this is the case, removing unnaturally favorable conditions for mice could also benefit seabirds by reducing mouse densities in these edge habitats. For example, successful nesting by both CAAU and SCMU quickly followed after manual removal of iceplant at the ESCC restoration plot (this study). Though sample sizes are very small, productivity for both species from these rocky crevice sites was very high.

The multi-way interactions between mice, owls, habitat type, climate, and seabird colony persistence is currently under study (Thomsen et al. in prep., Nur et al. in prep.). Many researchers have identified that Barn Owls as well as native mice have major impacts on the SCMU colony at SBI (e.g., Wolf et al. 2000, Burkett et al. 2003, Millus et al. 2007). These two native predators exhibit classic boom-bust population dynamics on SBI, with BNOW lagging Deer Mice; the seasonal as well as interannual relative abundances undoubtedly affect nesting seabirds at different scales. Direct predation by Barn Owls of adult seabirds that visit the nesting colony nocturnally is of particular concern. For example, during the SCMU nest initiation period of 1999, Barn Owl density on SBI was very high (approximately 30 individuals in March and April; Wolf et al. 2000). Adult SCMU mortality in 1999 was also exceptionally high; 165 carcasses were documented during the breeding season (versus 8, 16, and 35 in the preceding three years; Roth et. al 1997, Roth et al. 1998, Roth et al. 1999, Wolf et al. 2000).

There is also a potential indirect benefit to SCMU reproductive output during heightened BNOW population size through numeric reduction in deer mouse numbers by BNOW; this situation could theoretically increase colony productivity by decreasing egg depredation rates. However, data from the 1999 breeding season, as described above, suggests that this situation is unlikely to occur. Monitoring data indicated that SCMU productivity in that year did not change from the 1993-2002 mean (Schwemm and Martin 2005) at Cat Canyon, even though egg depredation rates decreased. At Nature Trail, both metrics decreased substantially. In other words, even though egg depredation rates decreased (perhaps due to lower mouse abundance lagging the high owl population in that year), productivity did not increase at either monitored plot, suggesting that lowered productivity may have been due to increased adult mortality. It therefore appears likely that any apparent benefit (as measured by the egg depredation statistic) to SCMU egg success was outweighed by the adult mortality, which also has far larger effects on colony persistence than does a decrease in annual reproductive output by this relatively long-lived species. Much more work is needed to quantitatively assess these relationships, and projects are ongoing (Thomsen et al. in prep., Nur et al. in prep). However, we strongly agree with previous researchers that Barn Owls continue to represent the greatest threat to colony persistence of the SCMU and other rare seabirds on SBI.

Summary of recommendations. In addition to the monitoring, research, and restoration approaches discussed below, there are several simple and practical actions that will greatly minimize the effects of human presence on SBI. These include:

- Schedule routine maintenance activities to avoid the nesting season. Examples include hydraulic repairs of the crane, pumping of the septic or outhouse facilities, and weed abatement and trail maintenance activities using weedwhackers or mowers.
- Annual clean up of Scripps's Murrelet nesting areas associated with the NPS structures on the island prior to the breeding season (January). For example, loose materials should be organized to avoid disturbance during the nesting season.
- Maintain the blackout curtains in the housing structures.
- Educate visitors about the need to stay on clearly marked trails.

- Continue to document bright lights from boats around SBI (including those from commercial and recreational vessels) and develop an outreach program to inform boaters of possible impacts.
- Regularly inspect and maintain island infrastructure to avoid creating drowning or entrapment hazards.
- Analyze noise abatement possibilities for crane operation and water delivery tasks.
- Prevent nonnative introductions (flora and fauna) by improving biosecurity protocols and public outreach efforts.

Storm-petrels. While the MSRP restoration project on SBI implemented during the current study does not specifically include storm-petrels as a target species, we believe that the overall goals of the project will benefit breeding petrels both directly and indirectly. However, a monitoring component must be established to determine whether this is ultimately the case. Specifically, the need for a standardized, long-term monitoring effort which includes mark-recapture studies has been identified by many previous researchers (see above). We agree with previous researchers that, because of the breeding habits of these species and resultant difficulty in performing standardized nest monitoring, mist-netting efforts have the best potential to provide robust information for long-term trend analysis. More effort is also needed to document adult petrel mortality due to avian predation in sea caves and the major offshore islets, as discussed in Whitworth et al. (2011). Analysis of existing mist-netting data would help inform survey protocol development as well as provide information regarding colony trends since the 1970s. From a restoration perspective, we believe that the strategies recommended below could assist with petrel colony expansion in the following ways: 1) efforts to reduce adult murrelet and auklet mortality would also benefit other small seabirds that nest at SBI, including the petrels; 2) an increased CAAU colony size could also provide additional breeding habitat for petrels, which may use burrows after CAAU have fledged for breeding habitat at other locations; 3) re-establishing a substantial CAAU colony, as existed historically on SBI (Grinnell 1897, Cooper *in* Howell 1917), would provide an alternate prey source for avian predators.

Scripps's Murrelets and Cassin's Auklets. Assessing the status and distribution of CAAU and SCMU annually should continue to be a top priority for the monitoring component of the restoration project. For SCMU, we recommend that minimum baseline annual nest monitoring be conducted in at least four plots: Cat Canyon, Landing Cove, Dock, and House. Nest checks should be conducted using a 10-day maximum survey interval to estimate the following basic parameters: 1) egg productivity and failure rates (including depredation rates); 2) clutch success; 3) clutches per site; and 4) phenology (minimum, maximum, mean and median initiation and hatching). Separate reporting of "historic" sites in Cat Canyon should be discontinued, as the historic site catalogue sample size does not appear sufficient to capture meaningful density trends**.** The more technically challenging Arch Point North Cliffs plot should be included in annual monitoring efforts if suitably trained staff is available.

We recommend that extended island-wide (including sea caves and offshore islets) surveys should be conducted periodically (every 2 to 5 years) to assess whether nesting has increased outside of standardized plots. Expanded at-sea banding efforts for SCMU could be implemented to increase the currently small sample of banded birds for future demography studies; periodic spotlight surveys to determine colony trends, as well as repeated prey sampling efforts, could be conducted as recommended in Whitworth et al. (2011). Analysis of past land-based plot monitoring data using retroactively standardized search areas within plots could be conducted to assess whether changes in plot density have occurred independently of changes in habitat availability. Remote data collection techniques, such as camera monitoring and the use of acoustic recording units (McKown et al. in prep, Harvey et al. in prep), should be further developed for both SCMU and CAAU to increase data collection capabilities while minimizing on-site researcher presence.

Study needs specific to the Scripps's Murrelet have been discussed extensively in previous reports and publications referenced in this document, and are only briefly summarized here. In particular, we recommend that study strategies be developed for:

- Determining parentage of multiple clutches within nest sites. Possible techniques include (a) genetic analysis of eggshells and (b) pit-tagging individual birds;
- Establishing a more robust approach for verifying the primary cause of depredated eggs. For example, temperature loggers could be tested to assess their utility in measuring adult site attendance and periods of egg neglect with respect to egg depredation;
- Identifying unknown life history parameters such as age at first breeding and longevity using mark-recapture or other techniques;
- Describing the largely unknown breeding biology of the species by analyzing the extensive archival nest camera footage from known nest sites at SBI;
- Developing social attraction techniques for this species to facilitate colony expansion into restored habitat.

Annual nest searches for both species in restoration plot areas will allow for continued detection of colony expansion into restored areas; changes in nesting distribution and density will be most appropriately interpreted by comparison to baseline, standardized monitoring data to assess restoration outcomes.

The initial success in 2011 of the social attraction work for the Cassin's Auklet restoration component of the program was very encouraging. While auditory attraction has been successfully used for other seabird species (e.g. Buxton and Jones 2012, McIver et al. 2013), the small colony established using social attraction in 2011 represents, to our knowledge, the first successful use of this technique for the CAAU. However, subsequent failure of this small new colony was attributed primarily to predation by Barn Owls, and social attraction was discontinued in the following breeding season as a result (Harvey et al. in prep). Of lesser concern, we also noted relatively high erosion in this area resulting from an insufficient period of plant establishment prior to social attraction. While SCMU nesting has not yet occurred under our native outplantings, our finding of heightened breeding success for this species from nest sites located beneath native plants in reproductive monitoring areas provides direct evidence that restoring native shrub communities on the island will provide long-term, measurable benefits for this and other species.

For these reasons, we recommend continued native plant restoration, coupled with a robust monitoring approach, as the best possible method for restoring self-sustaining populations of the small crevice and burrow nesting species on SBI. However, we strongly recommend that further social attraction for Cassin's Auklets (or other species) should not be attempted until a strategy to protect the remnant populations, as well as newly established colonies, from Barn Owl predation has been identified and implemented. Additionally, a sufficient timeline for native plant establishment must be incorporated into planning for social attraction endeavors. These strategies will help to ensure that sufficient cover and soil stabilization, as well as approaches to provide protection from aerial predators, are in place prior to establishing new colonies of seabirds.

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Appendix 1. Data collection fields used for standardized Scripps's Murrelet monitoring.

PDA Field Name	Type	Description
Program Code	Text	2 letter program code (SB for Seabird Program)
Year	Text	YYYY. Year in which survey was conducted
Island Code	Text	2 letter island code (SB= Santa Barbara Island)
Event Code	Text	Alphabetical code assigned chronologically per sampling event per year.
Observation Date	Date/Time	DD/MM/YYYY. Actual date when data collection took place.
Plot	Text	2 letter code for monitoring plot (BH=Bunkhouse, CC=Cat Canyon, DO=Dock, LC=Landing Cove, NT=Nature Trail)
Nest Number	Text	Unique identifier for an individual nest site (name or number)
Species	Text	4 letter code indicating species of bird occupying a site. Options include: ASSP=Ashy Storm-Petrel, CAAU= Cassin's Auklet, XAMU/SCMU=Scripps's Murrelet, N/A= Not applicable, empty site, Other (list in comments)
Observer	Text	Initials of primary observer.
Recorder	Text	Initials of data recorder.
Proofer	Text	Initials of the data proofer.
Adult Disturbed	Text	Y/N. Disturbance to adult murrelets during monitoring is a concern. Any disturbances should be described in the comments field.
Nest Contents	Text	The number of adults (SIN), eggs [E], and chicks [C] is recorded in the Nest Contentst field. Options include: 0, 1SIN, 1E, 2E, 1SIN+1E, 1SIN+2E, 1SIN+1C, 1SIN+2C, 1C, 2C, 2SIN, Comments, NC (not checked), 2SIN + 1E, 2SIN+2E, 2SIN+1C, 2SIN+2C
Egg1	Text	The status of the first (or only) egg. Options include: 0 (no egg), E (intact egg), DE (depredated egg), HE (hatched egg), BE (broken egg), Comments.
Egg 2	Text	The status of the second egg found. Options include: 0 (no egg), E (intact egg), DE (depredated egg), HE (hatched egg), BE (broken egg), Comments.
Egg Order Known	Text	Y/N. If the order in which the eggs were laid is known because the first egg was depredated or maked before the second egg was laid, then Yes is selected.
Chick1	Text	The status of the first (or only) chick found. Options inlcude: 0 (no chick), C (live chick), DC (dead chick), Comments.
Chick2	Text	The status of the second chick found. Options include: 0 (no chick), C (live chick), DC (dead chick), Comments.
Comment List	Memo	Comments generated by multiselection list in PDA. See Protocol for Monitoring SCMU Nesting Sites for definitions.
Comments	Memo	Comments manually entered into the PDA. Should begin with list of nest contents for active sites. The size characteristics and color of eggshells should be noted. If the fate of the egg is uncertain detailed notes should be entered.
Egg1 Length	Number	Length of Egg1 in millimeters. Measued using calipers if egg can be safely handled and adult is not present.
Egg1 Width	Number	Width of Egg1 in millimeters. Measured using calipers if egg can be safely handled and adult is not present.
Egg2 Length	Number	Length of Egg2 in millimeters. Measured using calipers if egg can be safely handled and adult is not present.
Egg 2 Width	Number	Width of Egg2 in millimeters. Measured using calipers if egg can be safely handled and adult is not present.

Appendix 2. Nest survey dates in 2010 for the seven Scripps's Murrelet standard monitoring plots.

Survey Date	Dock	House	LACO	Cat	APNC	W.Cliffs	Boxthorn
3/4/2010				x			
3/5/2010	x	x	x				
3/6/2010					x		
3/7/2010						x	
3/8/2010				x			
3/9/2010			x				x
3/10/2010	x	x					
3/13/2010				x			
3/14/2010	x	x					
3/17/2010	x	x					
3/18/2010				x			
3/19/2010					x		x
3/20/2010			x				
3/21/2010						x	
3/22/2010			x		x		x
3/24/2010	x	x					
3/28/2010				x			
3/31/2010	x	x					x
4/2/2010			x		x		
4/3/2010			x	x			
04/04/10						x	
4/5/2010			x		x		
4/6/2010				x			
4/7/2010	x	x					x
4/11/2010				x			
4/14/2010	x	x					x
4/15/2010				x			
4/16/2010			x		x		
04/17/10						x	
4/18/2010				x			
4/19/2010			x		x		
4/21/2010	x	x					
4/22/2010							x
4/23/2010				x			
4/28/2010	x	x					x
4/29/2010				x			
4/30/2010			x		x		

Appendix 2 continued.

Survey Date	Dock	House	LACO	Cat	APNC	W.Cliffs	Boxthorn
05/02/10						x	
5/3/2010			x		x		
5/4/2010				x			
5/5/2010	x	x					x
5/10/2010				x			
5/12/2010	x	x					
5/13/2010				x			
5/14/2010					x		
05/15/10			x				
5/16/2010							x
5/17/2010			x		x	x	
5/18/2010				x			
5/19/2010	x	x					x
5/26/2010	x	x					
5/27/2010				x			x
5/28/2010			x		x		
05/29/10						x	
5/31/2010			x		x		
6/1/2010				x			
6/2/2010	x	x					
6/6/2010				x			
6/9/2010	x	x					x
6/10/2010				x			
6/11/2010			x		x		
06/12/10						x	
6/14/2010			x		x		
6/15/2010				x			
6/16/2010	x	x					x
6/20/2010				x			
6/23/2010	x	x					x
6/24/2010				x			
6/25/2010			x		x		
06/26/10						x	
6/28/2010			x		x		
6/29/2010				x			
06/30/10	x	x					
7/4/2010				x			
7/7/2010		x					x
7/8/2010	x			x			

Appendix 2 continued.

Survey Date	Dock	House	LACO	Cat	APNC	W.Cliffs	Boxthorn
7/9/2010			x		x		
7/10/2010						x	
07/11/2010							
7/12/2010			x		x		
7/13/2010				x			
7/14/2010	x	x					
7/18/2010				x			
7/21/2010	x	x					
7/22/2010				x			
7/23/2010			x		x		
7/24/2010						x	
7/27/2010				x			
8/03/2010						x	

Appendix 3. Nest survey dates in 2011 for the five Scripps's Murrelet standard monitoring plots.

Survey Date	Dock	House	LACO	Cat	APNC
3/2/2011	x	x			
3/3/2011				x	
3/4/2011			x		x
3/8/2011				x	
3/9/2011	x	x			
3/11/2011			x		x
3/12/2011				x	
3/15/2011	x	x			
3/17/2011				x	
3/18/2011			x		x
3/22/2011				x	
3/23/2011	x	x			
3/26/2011					x
3/27/2011			x		
3/28/2011				x	
3/30/2011	x	x			
3/31/2011				x	
4/1/2011			x		x
4/5/2011				x	
4/6/2011	x	x			
4/8/2011			x		x
4/9/2011				x	
4/13/2011	x	x			
4/14/2011				x	
4/15/2011			x		x
4/19/2011				x	
4/20/2011	x	x			
4/22/2011			x		x
4/23/2011				x	
4/27/2011	x	x			
4/28/2011				x	
4/29/2011			x		x
5/3/2011	x	x		x	
5/6/2011			x		x
5/8/2011				x	
5/11/2011	x	x			
5/12/2011				x	
5/13/2011			x		x
5/17/2011				x	

Appendix 3 continued.

Survey Date	Dock	House	LACO	Cat	APNC
5/18/2011	x	x			
5/20/2011			x		
5/22/2011				x	
5/25/2011	x	x			
5/26/2011				x	
5/27/2011			x		
5/28/2011					x
5/31/2011				x	
6/1/2011	x	x			
6/3/2011			x		x
6/6/2011				x	
6/8/2011	x	x			
6/9/2011				x	
6/10/2011			x		x
6/14/2011				x	
6/15/2011	x	x			
6/18/2011			x		x
6/19/2011				x	
6/22/2011	x	x			
6/23/2011				x	
6/24/2011			x		x
6/28/2011				x	
6/29/2011	x	x			
7/1/2011		x	x		x
7/3/2011				x	
7/5/2011		x			
7/6/2011		x			
7/10/2011				x	
7/12/2011	x				
7/13/2011		x			

Appendix 4a. Ashy (ASSP) Storm-Petrels captured in mist nets at Santa Barbara Island in 2010.

Band Number	Species	New/Recapture	Capture Location	Capture Date
4501-41294	ASSP	New	SRO	6/4/2010
4501-41295	ASSP	New	SRO	6/5/2010
4501-41296	ASSP	New	SRO	6/5/2010
4501-41297	ASSP	New	SRO	6/5/2010
4501-41298	ASSP	New	SRO	6/5/2010
4501-41299	ASSP	New	SRO	6/5/2010
4501-41300	ASSP	New	SRO	6/5/2010
4501-41310	ASSP	New	SRO	6/5/2010
4501-41311	ASSP	New	SRO	6/6/2010
4501-41312	ASSP	New	SRO	7/8/2010
4501-41313	ASSP	New	SRO	7/8/2010
4501-41314	ASSP	New	SRO	7/9/2010
4501-41315	ASSP	New	SRO	7/9/2010
4501-41316	ASSP	New	SRO	7/10/2010
4501-41317	ASSP	New	SRO	7/10/2010
4501-41318	ASSP	New	SRO	7/10/2010
4501-41319	ASSP	New	SRO	7/10/2010
4501-41320	ASSP	New	SRO	7/11/2010
4501-41321	ASSP	New	SRO	7/11/2010
4501-41322	ASSP	New	SRO	7/11/2010

Appendix 4b. Ashy (ASSP) and Black (BLSP) Storm-Petrels captured in mist nets at Santa Barbara Island in 2011.

Band Number	Species	New/Recapture	Capture Location	Capture Date
1001-21558	BLSP	New	SRO	7/2/2011
1001-21561	BLSP	New	NC	7/3/2011
1001-21562	BLSP	New	NC	7/4/2011
1001-21563	BLSP	New	SP	7/4/2011
4501-41336	ASSP	New	SRO	6/4/2011
4501-41336	ASSP	New	SRO	7/2/2011
4501-41336	ASSP	Recap	SRO	7/2/2011
4501-41367	ASSP	New	SRO	6/4/2011
4501-41368	ASSP	New	SRO	6/4/2011
4501-41369	ASSP	New	SRO	6/4/2011
4501-41370	ASSP	New	SRO	6/4/2011
4501-41371	ASSP	New	SRO	6/5/2011
4501-41372	ASSP	New	SRO	6/5/2011
4501-41373	ASSP	New	ESC	6/30/2011
4501-41374	ASSP	New	ESC	6/30/2011
4501-41375	ASSP	New	ESC	6/30/2011
4501-41375	ASSP	New	ESC	7/29/2011
4501-41375	ASSP	Recap	ESC	7/29/2011
4501-41376	ASSP	New	ESC	6/30/2011
4501-41377	ASSP	New	ESC	6/30/2011
4501-41378	ASSP	New	ESC	6/30/2011
4501-41379	ASSP	New	ESC	6/30/2011
4501-41380	ASSP	New	ESC	6/30/2011
4501-41381	ASSP	New	ESC	6/30/2011
4501-41382	ASSP	New	ESC	6/30/2011
4501-41383	ASSP	New	ESC	7/1/2011
4501-41384	ASSP	New	ESC	7/1/2011
4501-41385	ASSP	New	ESC	7/1/2011
4501-41386	ASSP	New	SRO	7/1/2011
4501-41387	ASSP	New	SRO	7/1/2011
4501-41388	ASSP	New	SRO	7/1/2011
4501-41389	ASSP	New	SRO	7/2/2011
4501-41391	ASSP	New	SRO	7/2/2011
4501-41392	ASSP	New	SRO	7/2/2011
4501-41393	ASSP	New	SRO	7/2/2011
4501-41394	ASSP	New	SRO	7/2/2011

Appendix 4 continued.

Band Number	Species	New/Recapture	Capture Location	Capture Date
4501-41395	ASSP	New	SRO	7/2/2011
4501-41396	ASSP	New	SRO	7/2/2011
4501-41397	ASSP	New	SRO	7/2/2011
4501-41398	ASSP	New	SRO	7/2/2011
4501-41399	ASSP	New	SRO	7/2/2011
4501-41400	ASSP	New	SRO	7/2/2011
4501-41401	ASSP	New	SRO	7/2/2011
4501-41402	ASSP	New	SRO	7/2/2011
4501-41403	ASSP	New	SRO	7/2/2011
4501-41404	ASSP	New	SRO	7/2/2011
4501-41405	ASSP	New	NC	7/4/2011
4501-41406	ASSP	New	SP	7/4/2011
4501-41407	ASSP	New	SP	7/5/2011
4501-41408	ASSP	New	SP	7/4/2011
4501-41409	ASSP	New	SP	7/4/2011
4501-41410	ASSP	New	SP	7/5/2011
4501-41411	ASSP	New	ESC	7/5/2011
4501-41412	ASSP	New	ESC	7/5/2011
4501-41413	ASSP	New	ESC	7/5/2011
4501-41414	ASSP	New	ESC	7/5/2011
4501-41415	ASSP	New	ESC	7/5/2011
4501-41416	ASSP	New	ESC	7/5/2011
4501-41417	ASSP	New	ESC	7/5/2011
4501-41418	ASSP	New	ESC	7/5/2011
4501-41419	ASSP	New	ESC	7/6/2011
4501-41420	ASSP	New	ESC	7/6/2011
4501-41421	ASSP	New	ESC	7/6/2011
4501-41422	ASSP	New	NC	7/27/2011
4501-41423	ASSP	New	NC	7/27/2011
4501-41424	ASSP	New	NC	7/27/2011
4501-41425	ASSP	New	NC	7/27/2011
4501-41426	ASSP	New	NC	7/27/2011
4501-41427	ASSP	New	NC	7/27/2011
4501-41428	ASSP	New	NC	7/27/2011
4501-41429	ASSP	New	NC	7/27/2011
4501-41430	ASSP	New	NC	7/27/2011
4501-41431	ASSP	New	NC	7/27/2011
4501-41432	ASSP	New	NC	7/27/2011

Appendix 4 continued.

Band Number	Species	New/Recapture	Capture Location	Capture Date
4501-41433	ASSP	New	NC	7/28/2011
4501-41434	ASSP	New	NC	7/28/2011
4501-41435	ASSP	New	NC	7/28/2011
4501-41436	ASSP	New	SRO	7/28/2011
4501-41437	ASSP	New	SRO	7/28/2011
4501-41438	ASSP	New	SRO	7/28/2011
4501-41439	ASSP	New	SRO	7/28/2011
4501-41440	ASSP	New	SRO	7/29/2011
4501-41441	ASSP	New	SRO	7/29/2011
4501-41442	ASSP	New	SRO	7/29/2011
4501-41443	ASSP	New	SRO	7/29/2011
4501-41444	ASSP	New	ESC	7/29/2011
4501-41445	ASSP	New	ESC	7/30/2011
4501-41446	ASSP	New	ESC	7/30/2011
4501-41447	ASSP	New	ESC	7/30/2011
4501-41448	ASSP	New	ESC	8/27/2011
4501-41449	ASSP	New	ESC	8/27/2011
No band	BLSP	New	SRO	7/1/2011
No band	BLSP	Unknown	NC	7/3/2011
No band	BLSP	Unknown	ESC	7/5/2011
No band	BLSP	Unknown	NC	7/28/2011
No band	BLSP	Unknown	ESC	7/29/2011

Appendix 5. Calendar days corresponding to the reported phenology data and graphics.

Day	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Day
1	1	32	60	91	121	152	182	213	244	274	305	335	**1**
2	2	33	61	92	122	153	183	214	245	275	306	336	**2**
3	3	34	62	93	123	154	184	215	246	276	307	337	**3**
4	4	35	63	94	124	155	185	216	247	277	308	338	**4**
5	5	36	64	95	125	156	186	217	248	278	309	339	**5**
6	6	37	65	96	126	157	187	218	249	279	310	340	**6**
7	7	38	66	97	127	158	188	219	250	280	311	341	**7**
8	8	39	67	98	128	159	189	220	251	281	312	342	**8**
9	9	40	68	99	129	160	190	221	252	282	313	343	**9**
10	10	41	69	100	130	161	191	222	253	283	314	344	**10**
11	11	42	70	101	131	162	192	223	254	284	315	345	**11**
12	12	43	71	102	132	163	193	224	255	285	316	346	**12**
13	13	44	72	103	133	164	194	225	256	286	317	347	**13**
14	14	45	73	104	134	165	195	226	257	287	318	348	**14**
15	15	46	74	105	135	166	196	227	258	288	319	349	**15**
16	16	47	75	106	136	167	197	228	259	289	320	350	**16**
17	17	48	76	107	137	168	198	229	260	290	321	351	**17**
18	18	49	77	108	138	169	199	230	261	291	322	352	**18**
19	19	50	78	109	139	170	200	231	262	292	323	353	**19**
20	20	51	79	110	140	171	201	232	263	293	324	354	**20**
21	21	52	80	111	141	172	202	233	264	294	325	355	**21**
22	22	53	81	112	142	173	203	234	265	295	326	356	**22**
23	23	54	82	113	143	174	204	235	266	296	327	357	**23**
24	24	55	83	114	144	175	205	236	267	297	328	358	**24**
25	25	56	84	115	145	176	206	237	268	298	329	359	**25**
26	26	57	85	116	146	177	207	238	269	299	330	360	**26**
27	27	58	86	117	147	178	208	239	270	300	331	361	**27**
28	28	59	87	118	148	179	209	240	271	301	332	362	**28**
29	29		88	119	149	180	210	241	272	302	333	363	**29**
30	30		89	120	150	181	211	242	273	303	334	364	**30**
31	31		90		151		212	243		304		365	**31**
Day	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**DAY**

Appendix 6. CAAU and BNOW images captured by remote Reconyx cameras in the Landing Cove plot in 2011.

Condo Area	Date	Time	Species	Number	Activity
LLC	2/28/2011	0:16	CAAU	1	Standing on SE side of burrows
LLC	3/6/2011	22:39	CAAU?	1	Shadowy thing that might be bird SE of burrows in grass
LLC	3/6/2011	23:54	CAAU	1	In grass SE of burrows
LLC	3/6/2011	23:55	CAAU	1	SE of burrows but coming closer than last pic
LLC	3/6/2011	23:55	CAAU	1	SE of burrows, same spot as pic 6\5
LLC	3/7/2011	0:11	CAAU	1	SE of burrows, closer than pic6, wings up
LLC	3/7/2011	0:11	CAAU	1	SE of burrows, same spot as pic7, right behind board
LLC	3/7/2011	0:11	CAAU	1	SE of burrows, moved back towards grass
LLC	3/17/2011	6:03	CAAU	1	E of burrows, 1ft below bottom board
LLC	3/17/2011	6:03	CAAU	1	E of burrows, 1ft below bottom board
LLC	3/17/2011	6:03	CAAU	1	E of burrows, 1ft below bottom board
LLC	3/17/2011	6:13	CAAU	1	SE of burrows, wings up
LLC	3/17/2011	6:13	CAAU	1	E of burrows, 2ft below bottom board
LLC	3/17/2011	6:13	CAAU	1	E of burrows, further N than last pic
LLC	3/20/2011	4:54	CAAU	1	SE of burrows, wings up
LLC	3/20/2011	4:54	CAAU?	1	Can probably see head, SE of burrows in grass
LLC	3/20/2011	5:14	CAAU	2?	Both in flight E of burrows, can see one clearly, the other is just a blurry wing
LLC	3/22/2011	22:06	CAAU	2	One E of burrows a ft below board, one SE of burrows rt above bottom board
LLC	3/22/2011	22:26	CAAU	2	Same spots as before
LLC	3/22/2011	22:27	CAAU	1	Rt in front of burrow entrance, looks like it came out of burrow. Lower S burrow
LLC	3/23/2011	21:03	CAAU	2?	One seen clearly E of burrows, a ft below bottom board, 2nd one not clear - peeking out of burrow entrance, 3rd burrow to the N in bottom row
LLC	3/23/2011	21:04	CAAU	2?	One seen clearly E of burrows, a ft below bottom board, 2nd one not clear - peeking out of burrow entrance, 3rd burrow to the N in bottom row
LLC	3/23/2011	21:04	CAAU	2?	One seen clearly E of burrows, a ft below bottom board, 2nd one not clear - peeking out of burrow entrance, 3rd burrow to the N in bottom row
LLC	3/23/2011	21:19	CAAU	1	SE of burrows, wings up, can't see very clearly
LLC	3/23/2011	21:20	CAAU	1	SE of burrows
LLC	3/23/2011	21:20	CAAU	1	SE of burrows
LLC	3/24/2011	20:05	CAAU	1	SE of burrows, on top of lower board, wings up
LLC	3/24/2011	20:05	CAAU	1	SE of burrows, on lower board
LLC	3/24/2011	20:06	CAAU	1	SE of burrows, on lower board

Appendix 6 continued.

Condo Area	Date	Time	Species	Number	Activity
LLC	3/24/2011	20:09	CAAU	2	SE of burrows, one still perched on board, second one in flight rt below it.
LLC	3/24/2011	20:09	CAAU	2	SE of burrows, same spots, 2nd one on ground
LLC	3/24/2011	20:09	CAAU	2	Both below bottom board, more towards burrows
LLC	3/24/2011	20:51	CAAU	1	On top of lower board, SE of burrows
LLC	3/24/2011	20:51	CAAU	1	Behind lower board, SE of burrows
LLC	3/24/2011	20:51	CAAU	1	Behind lower board, SE of burrows
LLC	3/24/2011	21:17	CAAU	1	On top of lower board, SE of burrows
LLC	3/24/2011	21:17	CAAU	1	Behind lower board, SE of burrows
LLC	3/24/2011	21:18	CAAU	1	Behind lower board, SE of burrows
LLC	3/24/2011	21:21	CAAU	2?	First bird same as one seen in last few pics, same spot, wings up. Second bird, not clear, rt above lower roof.
LLC	3/24/2011	21:21	CAAU	2?	First bird same as one seen in last few pics, same spot. Second bird, not clear, rt above lower roof.
LLC	3/24/2011	21:21	CAAU	2?	First bird same as one seen in last few pics, same spot. Second bird, not clear, closer to N burrows
LLC	3/24/2011	21:49	CAAU	1	First bird in same spot, don't see second bird
LLC	3/24/2011	21:49	CAAU	1	First bird in same spot, don't see second bird
LLC	3/24/2011	21:49	CAAU	1	First bird moved a little more S
LLC	3/24/2011	22:50	CAAU	1	Not clear, but probably one bird in grass SE of burrows
LLC	3/30/2011	2:43-4:33	CAAU	1 to 2	Seen mostly in south east corner of condos. One seen at entrance of second burrow in the east grouping.
LLC	3/31/2011	21:54-21:55	CAAU	2	One in front of first south burrow in the east grouping and another below it to the east.
LLC	4/2/2011	0:09	CAAU	1	South east corner of condos
LLC	4/4/2011	20:46	CAAU	2	One in the middle burrow in the east grouping, and another infront of the natural burrow. SAA looked in the middle burrow in the east grouping and there was a SIN.
LLC	4/6/2011	22:53-22:54	CAAU	2	1 SE of condos, 1 near artificial and natural burrow in lower area
LLC	4/6/2011		CAAU	2	1 at entrance of lower W artificial burrow; Another one appears on pic 8-9 NE of bottom row
LLC	4/7/2011	5:25-5:26	CAAU	2	1 at entrance of lower S burrow, another downhill from burrow sites
LLC	4/8/2011	23:00-03:00	CAAU	3	2 Arrived around 23:00 then left and returned around 03:00. 1 sitting in (dirt) burrow downhill from artificial sites
LLC	4/9/2011	5:24	CAAU	3	1 in lowest (dirt) burrow, 1 walking around, 1 in upper northern burrow

Appendix 6 continued.

Condo Area	Date	Time	Species	Number	Activity
LLC	4/10/2011	2:23 and 5:26	CAAU	4	1 in lowest (dirt) burrow, 1 walking around lower, 1 in upper northern burrow, 1 walking around upper
LLC	4/11/2011	00:30-5:05	CAAU	4	similar movement as previous 2 days
LLC	4/12/2011	0:22	CAAU	1	walked towards speaker
LLC	4/12/2011	3:26	CAAU	2	1 in upper northern burrow, one walking near speaker
LLC	4/12/2011	5:04	CAAU	1	sitting on lowest terrace, flapping wings
LLC	4/13/2011	0:59	CAAU	2	1 bird in front of lower AB entrances, one peeking out of natural burrow
LLC	4/13/2011	4:40	CAAU	4	1 bird in front of upper burrow (rt side), 1 bird peeking out of lower left burrow, 2 birds in front of natural burrow
LLC	4/13/2011	4:41	CAAU	5	Same as last photo, but an additional bird SE of burrows
LLC	4/13/2011	4:41	CAAU	5	Two at upper, two at lower, one in front of natural burrow
LLC	4/13/2011	5:13	CAAU	1	1 peeking out of natural burrow
LLC	4/13/2011	22:52-22:57	CAAU	3	One bird flies in, can see bird peeking out of natural burrow, one of upper rt burrows, one on ground.
LLC	4/13/2011	4:49-5:13	CAAU	2	1 in front of natural burrow (then in last pic is peeking out of it), one SE of burrows
LLC	4/13/2011		CAAU		Peeked through entrances, NW most still has bird, and lower 3rd from rt still has bird. Natural burrow curves to right now and can't see all.
LLC	4/14/2011	1:52	CAAU	2	One at upper rt burrows, one near natural burrow.
LLC	4/14/2011	4:18-4:37	CAAU	3	Possible one peeking out of upper burrow, 3 near natural burrow.
LLC	4/15/2011	4:01	CAAU	3	CAAU appears SE of burrows, hops onto lower burrow terrace. Possible bird peeking out ofone of upper right burrows and natural burrow.
LLC	4/17/2011	23:34-23:35	CAAU	2	1 Bird appears SE of burrow, hops onto lower burrow terrace. 2nd bird peeking out of upper right burrow.
LLC	4/18/2011	1:09	CAAU	2	1 bird flies in, sits by natural burrow. 2nd bird peeks out of lower left burrow.
LLC	4/18/2011	1:23	CAAU	2	2 birds in front of lower burrows, 1 disappears
LLC	4/18/2011	1:55	CAAU	2	1 peeking out of upper right burrow, 1 sits in front of lower burrow and then hops off terrace, leaves.
LLC	4/18/2011	2:11	CAAU	3	1 peeking out of natural burrow, 1 outside of natural burrow, 1 flies up to lower burrow terrace.
LLC	4/19/2011	4:26	CAAU	3	1 sitting in front of lower burrows, 1 peeking out of natural burrow, 1 peeking out of top right burrow

Appendix 6 continued.

Condo Area	Date	Time	Species	Number	Activity
LLC	4/21/2011	10:17	CAAU	2	1 peeking out of second burrow in NE corner row. 1 inside the burrow to the E of the other bird.
LLC	4/22/2011	1:06	CAAU	3	1 peeking out of second burrow in NE corner interacting with another bird right outside burrow. 1 SW of lower row.
LLC	4/22/2011	1:18	CAAU	2?	1 peeking out of third burrow in NE corner row. 1 (probably CAAU) very blurry lifeform moving around lower COGI.
LLC	4/22/2011	1:18	CAAU	1	1 peeking out of third burrow in NE corner row.
LLC	4/23/2011	2:39	CAAU	2	1 peeking out of third burrow in NE corner. 1 SW of lower row.
LLC	4/23/2011	11:05-11:06	CAAU	4	1 peeking out of second and third burrow in NE corner. 1 SW of lower row. 1 next to speaker.
LLC	4/25/2011	1:19	CAAU	2 or 3	2 peeking out of second burrow in NE corner; maybe one peeking out of third burrow in NE corner. 1 SW of lower row flying to the next row up.
LLC	4/25/2011	0:28-0:29	CAAU	6	1 peeking out of third burrow in NE corner. 1 SW of lower row. 1 peeking out of second burrow in lower row. 3 next to speaker.
LLC	4/26/2011	0:02	CAAU	1	1 peeking out of natural burrow.
LLC	4/26/2011	1:04	CAAU	1	Hanging out SE of condos.
LLC	4/26/2011	2:33	CAAU	4	1 Hanging out SE of condos; 1 peeking out of natural burrow; One East of top row; 1 peeking out of third burrow in NE coner.
LLC	4/26/2011	1:42-1:43	CAAU	2	1 Hanging out SE of condos; 1 peeking out of natural burrow.
LLC	4/27/2011	0:48	CAAU	3	1 Hanging out SE of condos next to natural burrow; 1 peeking out of natural burrow; 1 peeking out of second burrow, lower row.
LLC	4/28/2011	4:03	CAAU	1	peeking head out of natural burrow below lower retaining wall to the right, same burrow that had peakign auklet at 22:35
LLC	4/28/2011	21:05	CAAU	1	jumped up to top of lower retaining wall, then to front of artificial burrow tube (left most of the row of three in the middle of the frame)
LLC	4/28/2011	21:57	CAAU	1	very blurry, jumped or flew in to top of lower retaining wall to left of screen, head blocked by vegetation for last 3 frames
LLC	4/28/2011	22:35	CAAU	2	bird flew in to front of natural burrow below lower retaining wall to right before vegetation blocks view, walks a bit past and second auklet pokes head out of burrow (cute!), can't tell if 1st CAAU headed for that burrow or to the right of it, pictures ended too soon!
LLC	4/28/2011	23:20	CAAU	1	flew in to corner of lower retaining wall (below it) and sit

Appendix 6 continued.

Condo Area	Date	Time	Species	Number	Activity
LLC	4/29/2011	2:49	CAAU	1	sitting below lower retaining wall to left of screen, tried to fly up terrace and failed, back to original spot
LLC	4/29/2011	4:29	CAAU	1	peeking head out of natural burrow below lower retaining wall to the right, left of speaker
LLC	4/29/2011	23:09	CAAU	1	sitting below lower retaining wall to left of screen, appears to be calling
LLC	4/30/2011	1:27	CAAU	1	auklet sitting in front of art burrow entrance under north most shade cover (2nd from East - or right), facing camera, mouse also in frame below terraces
LLC	4/30/2011	3:17	CAAU	1	auklet in same place as auklet at 1:27, but facing toward burrow entrance, mouse also in frame below terraces
LLC	4/30/2011	4:17	CAAU	2	1 sitting in entrance of natural burrow by speaker below terraces, other sitting a few feet to left below terraces
LLC	4/30/2011	12:29	CAAU	2	1 auklet peeking out nat burrow by speaker, 2nd auklet in close front left of screen and flew up behind veg to left of screen up side of slope
LLC	5/1/2011	1:01	CAAU	1	flew into lower retaining wall, bounced down below terrace and sat, tried again, didn’t make it, sat
LLC	5/1/2011	2:59	CAAU	1	peeking out of art burrow under N-most shade cover, second from right. Mouse also in screen below terraces.
LLC	5/1/2011	21:44	CAAU?	1?	very blurry and dark, but appears as though auklet might be sitting in entrance of art burrow under N-most shade cover, 2nd from the right
LLC	5/2/2011	3:11	CAAU	2	auklet sitting in entry of nat burrow by sound system, other auklet flew in to top of lower retaining wall on terrace and sat behind plant
LLC	5/2/2011	4:24	CAAU	2	auklet sitting to left below lower retaining wall, 2nd auklet peeking out of art burrow entry below second retaining wall from the bottom (first burrow if looking left to right), eye shine coming from art burrow under North-most shade cover, left most burrow just before COGI stalk, can't tell if auklet or mouse?
LLC	5/2/2011	12:05	CAAU	3	bird walking down and sit in front of bush directly in front of camera (below terraces), other auklet sitting in entry of nat burrow by sound system, 3rd auklet sitting in entry of art burrow under North-most shade cover, second from right. Still small smudge of something (mouse or auklet?) in art burrow under North-most shade cover, left most burrow just before COGI stalk...smudge appears to have moved a bit

Appendix 6 continued.

Condo Area	Date	Time	Species	Number	Activity
LLC	5/2/2011	22:20	CAAU	1	walking around in circles below terraces to left of screen, small smudge of something (mouse or auklet?) in art burrow under North-most shade cover, left most burrow just before COGI stalk
LLC	5/3/2011	1:49	CAAU	2	auklet sitting to left of nat burrow by speaker then walking towards it, 2nd auklet sitting in entry of art burrow under north-most shade cover (second from right)
LLC	5/3/2011	2:39	CAAU	4	auklet sitting in entry of art burrow under north-most shade cover (second from right), 2nd auklet peeking out of art burrow under east-most shade cover (second from left), 3rd auklet can see part of in nat burrow by speaker, 4th auklet flying from below terrace onto first terrace level and sitting by plant
LLC	5/3/2011	2:59	CAAU	2	auklet sitting in entry of art burrow under north-most shade cover (second from right), 2nd auklet hopped up from below terrace onto first terrace level and sitting by plant then walkign toward art burrow entrances under east-most shade cover
LLC	5/3/2011	3:32	CAAU	3	auklet sitting in entry of art burrow under north-most shade cover (second from right), 2nd auklet peeking out of art burrow under east-most shade cover (second from left), 3rd auklet landed and sit below terrace to left of screen
LLC	5/3/2011	3:55	CAAU	3	auklet sitting in entry of art burrow under north-most shade cover (second from right), 2nd auklet flying away in lower left corner of screen, 3rd auklet sitting below terraces to left of lower natural burrow
LLC	5/4/2011	22:26	CAAU	2	one peeking head out of nat burrow by speaker, other landed below retainign wall and hopped up to lower terrace to left of art burrows by plant
LLC	5/5/2011	21:36	CAAU + mouse	1	auklet sitting in entry of art burrow under north-most shade cover (second from right), mouse crawling around in fornt of camera
LLC	5/6/2011	1:02	CAAU	2	both landed below terrace, one walkedin front of and behind speaker and the other looks like contemplating flying up to first terrace
LLC	5/6/2011	1:13	CAAU	2	auklet sitting in entry of natural burrow by speaker, 2nd auklet sitting below lower retaining wall to left of screen and looking around

Appendix 6 continued.

Condo Area	Date	Time	Species	Number	Activity
LLC	5/8/2011	0:13	CAAU	2, 3?	1 peeking out of natural burrow, 1 peeking out of upper right burrow, possible third near natural burrow in photo 691
LLC	5/8/2011	1:29	CAAU, mouse	1,1	CAAU peeking out of natural burrow, mouse climbing on yarrow in foreground
LLC	5/14/2011	2:04	CAAU	1	Peeking out of natural burrow
LLC	5/15/2011	12:52	CAAU	2	One peeking out of natural burrow and possible one looking out of on of northern burrows. Also some mice pics.
LLC	5/18/2011	21:44	CAAU	1	One moving around on one of the upper burrows. You can see it's eye. A mouse is running around also
LLC	5/18/2011	22:20	CAAU	1	Peeping out of natural burrow
LLC	5/19/2011	0:19	CAAU	1	Wandering around outside of its house in the lower burrows
LLC	5/20/2011		CAAU?		Not visible in camera, but doing LC XAMU surveys, found what might be 2 more natural burrows. 1 at base of large COGI, below natural burrow that is visible on cam. Other new burrow (?) is on uphill side of trail across and slightly downhill from metal Do Not Enter sign. Can't see any CAAU w/ flashlight, but that may be b/c can't see to back of burrow.
LLC	5/21/2011	0:17	CAAU	1	Leaving its lower burrow
LLC	5/21/2011	22:03-23-08	CAAU, mouse	1,1	CAAU moving around in front of lower burrow, sometimes walking around in front, sometimes peeking out of burrow. mouse on ACMI in foreground
LLC	5/22/2011	3:53	CAAU	1	sitting in small ACMI below lower burrow terrace.
LLC	5/22/2011	0:18-0:23	CAAU, mouse	2, 1	2 CAAU, one in natural burrow peeking out, one moving around below lower burrow terrace. 1 mouse running around near upper burrows
LLC	5/23/2011	2:06	BNOW	1	flying into site and hangin out on the left hand side of upper burrows
LLC	5/23/2011	11:26	CAAU	1	CAAU peeking out of natural burrow. Mouse climbing on yarrow in foreground, then disappears and reappears running around near upper burrows
LLC	5/23/2011	22:22	CAAU, mouse	2	Mouse is checking out the camera, and you can just see the eye of a CAAU poking out of the natural burrow.
LLC	5/24/2011	1:22-1:28	CAAU, mouse	2,1	1 CAAU sitting in lower burrow closest to cam, 2nd CAAU running around below lower burrows. Mouse (?) perched on top of 3rd lower burrow from right
LLC	5/24/2011	2:01-2:04	CAAU	2	1 CAAU peeking out of natural buurow, then disappears. 1 CAAU sitting in ACMI to left (in view) of natural burrow, then flies away.

Appendix 6 continued.

Condo Area	Date	Time	Species	Number	Activity
LLC	5/25/2011	10:45	CAAU	1	1 bird on south side
LLC	5/26/2011	22:33	CAAU	1	sitting in nest on N side under vegatation
LLC	5/26/2011	22:33	CAAU, mouse		mouse is running around in front of the camera, CAAU sitting in nest on N side under vegatation
LLC	5/27/2011	3:49	CAAU	1	CAAU is sitting in front of camera
LLC	5/27/2011	3:49	CAAU	1	CAAU is flying away from lower burrows
LLC	5/27/2011	4:28	CAAU	1	CAAU facing away from camera beneath lower burrows
LLC	5/29/2011	4:28	CAAU	1	CAAU is walking away from camera
LLC	5/29/2011	4:28	CAAU	1	CAAU sitting below lower burrows facing aay from camera and looking around
LLC	5/29/2011	22:43	CAAU?	1	eyespot visible SE of upper burrows
LLC	5/29/2011	22:43	CAAU?	1	two eyespots visible SE of upper burrows…possible bird
LLC	6/1/2011	3:02	CAAU	1	CAAU sitting in ACMI on left, looking around
LLC	6/3/2011	3:27	CAAU	1	1 CAAU sitting in upper right burrow - just visible at the very top, just to the right of little COGI. Also blurry UFO near COGI, only in photo 41 - maybe eyeshine of a CAAU flying away?
LLC	6/4/2011	4:34	CAAU (?) , mouse	1,1	CAAU (? Can only see eyeshine…) sitting in upper right burrow as before, mouse makes an appearance only in photo 1 in bottom left.
LLC	6/4/2011	20:54	CAAU (?) , mouse	1,1	mouse running around in foreground on left, possible CAAU sitting on upper burrow terrace, just below upper burrows on left. Very dark and blurry, hard to tell.
LLC	6/5/2011	3:55	CAAU	1	sitting below lower burrow terrace, contemplating hopping up there
LLC	6/7/2011		CAAU	2	Both surveying the scene from their burrows. 1 in upper right burrow, 1 in lower burrow (3rd from left).
LLC	6/9/2011	1:25, 2:58, 3:07	CAAU	1	at SE corner.
LLC	6/11/2011	1:34	CAAU, mice	1. 2	
LLC	6/11/2011	4:24	CAAU	1	
LLC	6/18/2011	21:48	CAAU, mouse	1,1	CAAU flying away, Top left corner. Mouse walkng away, bottom left corner.
LLC	6/20/2011	23:05	CAAU?	1	looks like a CAAU, sitting on left in ACMI, but can only really see eyespot and it is half out of the frame, so not 100% sure

Appendix 6 continued.

Condo Area	Date	Time	Species	Number	Activity
LLC	7/18/2011	9:25	CAAU	1	walked up from below camera, then flew off.
LLC	3/25-3/26/2011	23:01-02:23	CAAU	2	2CAAU , 24 photos of them around lower burrows, can see them in entrances of 3 lower burrows, sometimes just a head peeking out
LLC	3/26-3/27/2011	21:00-5:35	CAAU	1 to 4	Seen around burrows and in natural burrow, and first two south burrows in the east grouping.
LLC	3/27-3/28/2011	20:36-03:31	CAAU	1 to 2	Seen around burrows and in natural burrow and second burrow in the east grouping.
LLC	3/30-3/31/2011	21:36-5:26	CAAU	1	Seen at south east corner of burrows. Note that the natural burrow looks different in the later photos.
LLC	4/1-4/2/2011	21:24-3:01	CAAU	2	One on the south east corner of condos and another appears later infront of natural burrow.
MLC	4/12/2011	0:57	CAAU	1	appraches burrows then appeared to have flown away
MLC	4/16/2011	2:45	CAAU	1	bird sat to left of speaker
MLC	4/16/2011	5:34	CAAU	1	bird sat on top of speaker
MLC	4/17/2011	1:08	CAAU	1	bird peeking out of farthest right burrow
MLC	4/17/2011	4:11	CAAU	1	possible bird behind center burrow - bright eyespot (?) intermittently visible, esp. in photo 124
MLC	5/1/2011	3:52	BNOW	1	landed on rocks where mouse was scurrying at 3:14, looked around, then flew off
MLC	6/6/2011	1:19	CAAU?	1	eyeshine visible above and behind lower burrows, just under the wooden cover. Can't tell if it is a mouse or CAAU.
MLC	6/12/2011	0:09	BNOW	1	Flew in and landed at SE ABS, never took pics of it flying away. Checked that burrow, which is occupied by mice. Mouse seen by that burrow in previous pics. No CAAU carcasses found in that area when checked that morning.
MLC	6/16/2011	21:37	BNOW	1	Sitting on the ground facing the camera on the left side of the frame, flies away in the last shot.
MLC	6/22/2011	23:54	BNOW, mice	1,2	1 BNOW perched on roof of burrows in back, looking intently to its right. 2 idiot mice running around to left of ERGC
MLC	7/15/2011	23:11	BNOW	1	sitting on left, looking around
MLC	7/27/2011	12:09	CAAU		Behind the front row of condos, to the right.
MLC	7/31/2011	2:38	BNOW	1	Landing on top of the condos.

Appendix 7. Scripps's Murrelets captured using the dipnet method at Santa Barbara Island in 2011.

Disposition	Band Number	Capture Date	Original Banding Date	Capture Time	BroodPatch
NEW	1262-03275	5/12/2011	5/12/2011	22:04	0
NEW	1262-03276	5/12/2011	5/12/2011	22:16	0
NEW	1262-03285	5/13/2011	5/13/2011	0:03	0
NEW	1262-03286	5/13/2011	5/13/2011	0:14	0
NEW	1262-03287	5/13/2011	5/13/2011	0:19	0
NEW	1262-03288	5/13/2011	5/13/2011	0:36	0
NEW	1262-03289	5/13/2011	5/13/2011	0:44	0
NEW	1262-03290	5/13/2011	5/13/2011	0:58	0
NEW	1262-03291	5/13/2011	5/13/2011	1:08	0
NEW	1262-03292	5/13/2011	5/13/2011	1:20	0
NEW	no band	5/13/2011	not banded	1:29	3
NEW	1262-03294	5/13/2011	5/13/2011	1:37	0
NEW	1262-03277	5/13/2011	5/13/2011	21:32	0
NEW	1262-03278	5/13/2011	5/13/2011	21:48	0
NEW	1262-03279	5/13/2011	5/13/2011	21:55	3
NEW	1262-03280	5/13/2011	5/13/2011	22:58	0
NEW	1262-03281	5/13/2011	5/13/2011	23:10	0
NEW	1262-03282	5/13/2011	5/13/2011	23:33	0
NEW	1262-03283	5/13/2011	5/13/2011	23:48	0
NEW	1262-03284	5/13/2011	5/13/2011	23:58	0
NEW	no band	5/16/2011	not banded	22:10	0
RECAP	1262-03252	5/13/2011	5/5/2010	0:53	3
RECAP	1262-03024	5/16/2011	4/26/2009	22:00	4